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PART II

FEDERAL ENERGY ADMINISTRATION

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INDUSTRIAL ENERGY CONSERVATION PROGRAM

Final Industrial Energy Efficiency Improvement Targets

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Final Industrial Energy Efficiency Improvement Targets

AGENCY: Federal Energy Administration (FEA).

ACTION: Notice.

SUMMARY: The Federal Energy Administration (FEA hereby establishes final energy efficiency improvement targets for the 10 most energy-consumptive manufacturing industries in the United States. The Energy Policy and Conservation Act requires FEA to publish these targets in the FEDERAL REGISTER, together with a statement of the basis and justification for each target. Such statements are included as appendices to this notice.

EFFECTIVE DATE: Date of issuance.

FOR FURTHER INFORMATION CONTACT:

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SUPPLEMENTARY INFORMATION: Part D, Title III of the Energy Policy and Conservation Act, Pub. L. 94–163 (EPCA) (42 U.S.C. 6341–6345), requires that FEA establish a program to promote increased energy efficiency by American industry. This program includes the identification and ranking of the major energy-consumptive manufacturing industries, the establishment of energy efficiency improvement targets for at least the 10 most energy-consumptive industries, the identification of major energy-consuming corporations within those industries for the purpose of determining those which must report progress in improving energy efficiency, and the establishment of a reporting system that provides for either the reporting by the identified corporations of energy efficiency information directly to FEA or, upon exemption, the reporting of such information indirectly through sponsors.

In accordance with section 373 of the EPCA, FEA has identified the 10 most energy-consumptive industries in the United States (41 FR 12766, March 26, 1976). These industries, described according to the two-digit Standard Industrial Classification (SIC) Manual published by the Office of Management and Budget, are as follows:

Ranking	Industry	SIC No.
1	Chemicals and allied products	28
2	Primary metal industries	33
3	Petroleum and coal products	29
4	Stone, clay, and glass products	32
5	Paper and allied products	26
6	Food and kindred products	20
7	Fabricated metal products	34
8	Transportation equipment	37
9	Machinery, except electrical	35
10	Textile mill products	22

Within each of the 10 identified industries, FEA has identified the corporations that (1) consume at least one trillion British thermal units (Btu's) of energy per year in the United States, and (2) are among the 50 most energy-consumptive corporations in the industry (41 FR 54977, December 16, 1976).

With the establishment of the final energy efficiency improvement targets, the chief executive officer of each corporation identified by FEA is required by section 375 of the EPCA to report to FEA on the progress made by the corporation toward meeting the target set for the industry of which such corporation is a part, unless the corporation is exempt from mandatory reporting under section 376(g) of the EPCA. Participation by a corporation in an "adequate voluntary reporting program" is the basis for exemption. FEA has published criteria which a voluntary reporting program must meet for a corporation reporting pursuant to it to be exempt under section 376(g) (41 FR 51866, November 24, 1976) and, after publishing for comment a preliminary list (42 FR 15731, March 23, 1977), has published a final list of exempt corporations on May 9, 1977 (42 FR 23538).

The form to be used by nonexempt corporations was published in the FEDERAL REGISTER for comment on May 4, 1977 (42 FR 22581), and a public hearing was held on May 17, 1977. After consideration of the comments by FEA and completion of the required review by the General Accounting Office, the final form will be published by FEA in the FEDERAL REGISTER and will be made available for distribution. The first submission of reports by nonexempt corporations to FEA will be required within four weeks of the publication of the form.

INDUSTRIAL ENERGY EFFICIENCY IMPROVEMENT TARGETS

On October 27, 1976, FEA issued for public comment proposed energy efficiency improvement targets (41 FR 48169, November 2, 1976). Public hearings were held for each proposed target in Washington, D.C., between November 22, 1976, and December 10, 1976. Written comments on the targets were also received by FEA.

A discussion of the comments received with regard to a particular industry is contained in each statement of basis and justification that is appended to this notice, as well as in the target support documents that are available for public inspection at the locations and times set forth below. The comments were reviewed by FEA, the Department of Commerce (DOC), the Energy Research and Development Administration (ERDA), and the contractor which prepared the support documents for FEA. Where changes were required in data and analysis which affected the final target value, they are noted and explained in the statement of basis and justification and in the target support documents.

After consideration of the comments and all other information available to FEA, FEA hereby establishes the voluntary energy efficiency improvement targets for the 10 most energy-consumptive industries in the United States as follows:

Rank	SIC No.	Industry	Proposed net target (percent)	Final (percent)	
				Net target	Offset
1	28	Chemicals and allied products	(16)	14	3
2	33	Primary metal industries	(10)	9	5
3	29	Petroleum and coal products	(12)	12	8
4	32	Stone, clay and glass products	(17)	16	0
5	26	Paper and allied products	(12)	20	3
6	20	Food and kindred products	(14)	12	1
7	34	Fabricated metal products	(24)	24	1
8	37	Transportation equipment	(16)	16	2
9	35	Machinery except electrical	(15)	15	2
10	22	Textile mill products	(27)	22	3

The table sets forth the net targets for each industry according to the order in which each industry ranks in energy consumption, and also includes the proposed target and the offset (from a gross target) that reflects the energy requirements of special circumstances. In four industries—petroleum and coal products; fabricated metals; machinery except electrical; and transportation equipment—the final net target is unchanged from the proposed target. In five industries—fod and kindred products; textile mill products; chemicals and allied products; stone, clay, and glass products; and primary metal industries—the final net target is lower than the proposed target. In one industry, paper and allied products, the final target shows an increase over the proposed target, and the final target has been set on the basis of fossil fuel and purchased energy instead of on the basis of total energy as originally proposed.

BASIS AND JUSTIFICATION FOR THE TARGETS

As required by section 374(a) (1) and (2) of the EPCA, each energy efficiency improvement target is based on the best available information and is established at the level which represents the maximum feasible improvement in energy efficiency that each industry can achieve by January 1, 1980, taking into account considerations of the technological feasibility and economic practicability of utilizing alternative operating procedures and more energy efficient technologies, as discussed below. Each target represents the percentage reduction in energy consumed per unit of output or activity that can be achieved between calendar year 1972 and January 1, 1980. The statement of the basis and justifica-

tion for each target is a synthesis of the significant data and determinations in the target support documents (listed in the section of this notice entitled "Public Access to Further Materials") that were prepared for FEA under contract with six contractors as adjusted to reflect public comments and FEA's determinations.

Each target was established according to a methodology which reflects the factors required to be considered by section 374(b) of the EPCA: (1) The objectives of the industrial energy conservation program, that is, to promote increased energy efficiency by American industry; (2) the technological feasibility and economic practicability of utilizing alternative operating procedures and more energy efficient technologies; (3) any special circumstances or characteristics of an industry; and (4) any actions planned or implemented by an industry to reduce consumption of petroleum products or natural gas. This methodolgy is, in turn, reflected in the statements of the basis and justification of each target which is included in this notice as appendices A–J. However, because the targets are based on the best available information and the extent of information available varied among industries, the target support documents prepared in accordance with the methodology contain varying levels of data and analysis and, therefore, each basis and justification also varies.

A description of the content of the statements of the basis and justification is provided as follows in the same format as appears in the statements themselves:

I. INDUSTRY DESCRIPTION AND ENERGY BASE

Each industry is briefly described and information on energy sources and consumption during the 1972 base year is presented. This data was used in projecting energy consumption by the industry by the January 1, 1980, target date and in assessing the conservation contribution of potential measures. Also included is a breakout and description of either the SIC three- or four-digit product classifications and/or other industry components that comprise the particular industry.

While section 374(a)(1) of the EPCA requires that targets shall be based on the best available information, the extent of available information varies from industry to industry. In particular, those industries which are less energy intensive or are more fragmented tend to have less comprehensive energy data than those for which energy costs have always been a major concern. The depth of analysis performed in establishing an industry target depended on the amount of relevant information that was available.

As required by section 371 of the EPCA, each of the 10 identified industries is a two-digit product classification according to the SIC Manual. The SIC Manual further divides each industry into three- and four-digit product classifications. For each industry, one of these or perhaps some other grouping of the industry components was chosen as the appropriate means of evaluating the applicability of potential conservation measures, depending on the availability of valid information on the energy consumption patterns within the industry. In several cases where one or more components of the industry accounted for the majority of the energy consumed by the industry, those components alone were studied in detail as representative of the entire industry.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

For each industry a list of potential conservation measures was identified for screening. These potential measures include both alternative operating procedures and more efficient technologies—that is, both new processes and new or altered equipment.

A. Technological feasibility. While the criteria for technological feasibility necessarily vary from industry to industry, some of the primary criteria included determining if the measure had been sufficiently accepted by the industry, if it could be implemented on a wide basis before the target date, and if it could bring significant energy savings without affecting the product produced or the processes used. The categories of measures evaluated could include: theoretical measures (ultimate limit in energy efficiency); development measures (proved only in laboratory or pilot scale); new and old plant measures (both innovative and conventional design). In some cases, the actual cost of implementing the measure, including manpower and resource costs, was considered.

B. Economic practicability. In general, only those measures that survived the technological screening were evaluated for economic practicability. In some instances conservation measures such as improved housekeeping that would require insignificant capital expenditures were not subjected to an economic screening. Some important criteria included considerations of the economic structure and operation of the industry, such as size, age, and geographical distribution, and projections concerning the future economic conditions of the industry that considered inflation, productive capacity utilization, and operating revenues and expenses.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

The manner in which each industry allocates funds for discretionary investment and whether such funds would be available in the years remaining before the target date were considered in order to determine the conservation measures which could be implemented.

A. Required return on investment. For each industry the appropriate method of calculating return on investment was chosen in order to determine if each potential conservation measure would be considered an attractive investment opportunity in the industry.

B. Capital spending priorities. In addition, the future availability of capital and the priorities for allocating capital were considered to evaluate if the industry could, in fact, implement any or all of the potential conservation measures.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE CONSUMPTION OF PETROLEUM PRODUCTS AND NATURAL GAS

A. Potential measures identified. The technological and economic evaluations of potential measures were integrated to determine the set of potential conservation measures that would give the maximum feasible improvement in energy efficiency. The statements generally list those significant potential conservation measures that were finally used in calculating the target value.

B. Efforts to reduce consumption of petroleum products and natural gas. Any actions planned or implemented by an industry to reduce its consumption of petroleum products and natural gas through conversion to coal or other fuels were considered. The energy inefficiencies caused by such conversion would result in increased energy consumption. It is apparent, however, that none of the target industries would be able to make a sufficient conversion away from scarce fuels to require any adjustments in the target values by January 1, 1980. Each statement discusses the trends in fuel sources within the industry and the conditions which foreclose conversion to coal.

V. PROPOSED TARGET DEFINITION

A. *Component goals.* For each industry the maximum feasible improvement in energy efficiency that could be achieved by January 1, 1980, was first determined by means of component goals. Each component goal was calculated by determining the energy which would be saved by the target date by applying those technologically feasible and economically practicable conservation measures that could be applied to the manufacturing processes of the component. The percentage increase in energy efficiency for the component which resulted from implementing conservation measures is the component goal.

B. Proposed two-digit gross target. The proposed two-digit gross target for each industry is the weighted average of the component goals using the amount of energy consumed by the component as the weighting factor, unless a different method is described in a particular statement.

C. Special circumstances effect. Under section 374(b)(3) of the EPCA, FEA is required to consider any special circumstances or characteristics of each industry in setting the targets. FEA has defined special circumstances and characteristics to mean any requirement or condition that (i) would necessarily result in energy consumption between 1972 and January 1, 1980, beyond the consumption projected for that period in the determination of gross targets and (ii) was not under the discretionary control of the plant operator. Included in such require-

ments and conditions are various government environmental, health and safety regulations, as well as various other changes beyond the control of industry, such as declining quality of ore grade and alterations in product mix or changes in product characteristics.

In most of the identified industries, the energy consumption required for special circumstances was determined for each component industry or for the components that were selected for a detailed study. In some cases where it was impossible to calculate the energy consumption for special circumstances because of incomplete data, the estimated percentage effect of special circumstances was substituted.

The impact of special circumstances must be taken into account to give an accurate picture of an industry's progress in improving energy efficiency and to insure that attainment of the targets is technologically feasible and economically practicable. If the impact of the special circumstances were not separately identified, it is conceivable that savings obtained through energy conservation measures would be partially or totally offset by the increased energy requirements of, e.g., Federal regulation, the result being a showing of little or no improvement in energy conservation by the industry.

D. *Proposed two-digit net target.* After the special circumstances for an industry were isolated, the effect of those demands on energy consumption between 1972 and January 1, 1980, was subtracted from the gross target to produce the net targets that were proposed in November. These targets were often a lower percentage number than the voluntary targets established under the DOC/FEA industrial conservation program because the DOC/FEA targets were mostly gross targets.

IV. FINAL TARGET DEFINITION

A. Comments and impact on the proposed target. As noted above, each statement contains a discussion of the important written and oral comments received by FEA subsequent to the publication of the proposed targets. The discussions in general treat the comments by topic covered, rather than answering each individual comment separately. Where the comments and accompanying data or subsequent FEA review and analysis have resulted in changes effecting the final target value, these changes are noted.

B. Final target. A table is provided at the end of each statement showing for each industry the final values assigned to (1) the gross target, (2) any offset for special circumstances, and (3) the resulting final net target. Also provided is a tabulation of projected energy consumption by 1980 assuming the attainment of the gross target.

Public Access to Further Materials

The statements of the basis and justification for each of the targets established today are derived, for the most part, from the detailed studies and analyses upon which the targets are based. The titles of these documents are listed below:

SIC 20

Draft Target Support Document—Energy Efficiency Improvement Targets Food and Kindred Products Industry, June 30, 1976.

Appendix Report: Part I—Energy Efficiency Improvement Targets Food and Kindred Products Industry, June 30, 1976.

Appendix Report: Part II—Energy Efficiency Improvement Targets Food and Kindred Products Industry, June 30, 1976.

Final Report—Energy Efficiency Improvement Targets Food and Kindred Products Industry, April 1, 1977.

SIC 22

Draft Target Support Document—Energy Efficiency Improvement Target in the Textile Mill Product Industry (SIC 22), June 26, 1976.

Final Target Support Document—Energy Efficiency Improvement Target in the Textile Mill Product Industry (SIC 22), February 4, 1977.

SIC 26

Draft Target Support Document for Energy Efficiency Improvement Target in the Paper and Allied Products Industry (SIC 26), September 1976.

Appendix To Draft Target Support Document for Energy Efficiency Improvement Target in the Paper and Allied Products Industry (SIC 26), September 1976.

Final Target Support Document for Energy Efficiency Improvement Target in the Paper and Allied Products Industry (SIC 26), March 1977.

SIC 28

Draft Target Support Document on Developing a Maximum Energy Efficiency Improvement Target for SIC 28: Chemical and Allied Products, July 1, 1976.

Appendixes Part 1 for Draft Target and Support Document on Developing a Maximum Energy Efficiency Improvement Target for SIC 28: Chemical and Allied Products, July 1, 1976.

Appendixes Part 2 for Draft Target and Support Document on Developing a Maximum Energy Efficiency Improvement Target for SIC 28: Chemical and Allied Products, July 1, 1976.

Revisions and Addenda to Draft Target and Support Document on Developing a Maximum Energy Efficiency Improvement Target for SIC 28: Chemicals and Allied Products, November 18, 1976.

Further Revisions to Draft Target and Support Document on Developing a Maximum Energy Efficiency Improvement Target for SIC 28: Chemicals and Allied Products, November 30, 1976.

Maximum Energy Efficiency Improvement Target for SIC 28: Chemicals and Allied Products, March 4, 1977.

SIC 29

An Energy Conservation Target for Industry SIC 29, June 25, 1976.

Technical Appendices to An Energy Conservation Target for Industry SIC 29, June 25, 1976.

Industrial Energy Efficiency Improvement Targets (SIC 29), Petroleum and Coal Products Final Target Documentation, March 3, 1977.

SIC 32

Draft Report on Development and Establishment of an Energy Efficiency Improvement Target for SIC 32: Stone, Clay, and Glass Products, June 25, 1976.

Draft Report (Appendices) on Development and Establishment of an Energy Efficiency Improvement Target for SIC 32: Stone, Clay, and Glass Products (3 volumes), June 25, 1976.

Final Report on Development and Establishment of an Energy Efficiency Improvement Target for SIC 32: Stone, Clay, and Glass Products, March 10, 1976.

SIC 33

Volume I—Target Support Document—Draft Target Report on Development and Establishment of Energy Efficiency Improvement Targets for Primary Metal Industries; SIC 33, August 13, 1976.

Volume II—Appendixes—Draft. Target Report on Development and Establishment of Energy Efficiency Improvement Targets for Primary Metal Industries (SIC 33), August 13, 1976.

Final Target Documentation on Draft Target Report on Development and Establishment of Energy Efficiency Improvement Targets for Primary Metal Industries (SIC 33), March 10, 1977.

SIC 34

Draft Target Support Document on Development and Establishment of Energy Efficiency Improvement Targets for Fabricated Metal Products (SIC 34), June 28, 1976.

Revised Target Support Document on Energy Efficiency Improvement Target for SIC 34—Fabricated Metal Products, March 15, 1977.

SIC 35

Energy Efficiency Improvement Targets in the Machinery (except Electrical) Industry (SIC 35), March 15, 1977. (This volume contains Section I through XIII, except for Section III, together with all exhibits and appendices.)

Target Support Document Energy Efficiency Improvement Targets in the Machinery (except Electrical) Industry (SIC 35), July 12, 1976. (This volume contains Section III with all tables.)

Energy Efficiency Improvement Targets in the Machinery (except Electrical) Industry (SIC 35)—Final Target Document, January 1977.

SIC 37

Energy Efficiency Improvement Targets in the Transportation Equipment Industry (SIC 37), July 12, 1976. (This volume contains Section I through XI, except for Section III, together with all exhibits and appendices.)

Target Support Document Energy Efficiency Improvement Targets in the Transportation Equipment Industry (SIC 37), July 12, 1976. (This volume contains Section III with all tables.)

Energy Efficiency Improvement Targets in the Transportation Equipment Industry (SIC 37)—Final Target Document, January 1977.

Because of their great significance as energy conservation source documents and their status as the underlying support to the basis and justification for each target, copies of these detailed studies and analyses, referred to in the statements as "target support documents," will be available for inspection at the FEA Freedom of Information Office, Room 2107, Federal Building, 12th and Pennsylvania Avenue NW., Washington, D.C., between the hours of 8:30 a.m. and 4:30 p.m., Monday through Friday, and at each FEA regional office as follows:

Region	Address	Hours
I	Analex Bldg., FEA Library, 150 Causeway St., Boston, Mass. 02114.	8:30 to 5.
II	Room 3400, 26 Federal Plaza, New York, N.Y. 10007.	8:30 to 5.
III	Room 1011, 1421 Cherry St., Philadelphia, Pa. 19102.	8 to 4:30.
IV	8th Floor, 1655 Peachtree St., N.E., Atlanta, Ga. 30309.	8 to 4:30.
V	Room A-333, 175 West Jackson Blvd., Chicago, Ill. 60606.	8 to 4:30.
VI	Room 280, 2626 W. Mockingbird Lane, Dallas, Tex. 75235.	8 to 4:30.
VII	Third Floor Library, 112 East 12th St., Kansas City, Mo. 64106.	7:30 to 4.
VIII	Room 206, 1075 South Yukon St., Lakewood, Colo. 80226.	7:30 to 4:30.
IX	Third Floor Reading Room, 111 Pine St., San Francisco, Calif. 94111.	7:30 to 3.
X	Room 1992, 915 2d Ave., Seattle, Wash. 98174.	8 to 4.

NOTE.—The establishment of the targets has been reviewed in accordance with Executive Order 11821 and OMB Circular No. A-107, and has been determined not to require evaluation of its economic impact as provided for therein.

(Energy Policy and Conservation Act, Pub. L. 94-163, as amended by Pub. L. 94-385; Federal Energy Administration Act of 1974, Pub. L. 93-275, as amended by Pub. L. 94-385; E.O. 11790, 39 FR 23185.)

The effective date of this document is the date of issuance.

Issued in Washington, D.C., June 1, 1977.

ERIC J. FYGI,
Acting General Counsel
Federal Energy Administration.

APPENDIX A: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 20—FOOD AND KINDRED PRODUCTS

I. INDUSTRY DESCRIPTION AND ENERGY BASE

Food and kindred products Standard Industrial Classification Code (SIC) 20 is comprised of 47 four-digit product classifications of foods and beverages for human and animal consumption including certain related products such as manufactured ice. These 47 classifications themselves include companies involved in diverse production efforts, but much information is available only at the four-digit level. The following table identifies the forty-seven SIC 20 classifications and gives information on energy consumption for each classification in 1972, the base year:

SIC	Component industry	1972 energy consumed 10^{12} Btu's	Percent of total SIC 20 consumption
2063	Beet sugar	88.7	8.5
2046	Wet corn milling	63.5	6.1
2011	Meat packing plants	87.3	8.3
2082	Malt beverages	50.1	4.8
2033	Canned fruits and vegetables	52.6	5.0
2026	Fluid milk	50.5	4.8
2051	Bread, cake, and related products	54.2	5.2
2075	Soybean oil mills	43.0	4.1
2062	Cane sugar refining	35.9	3.4
2037	Frozen fruits and vegetables	25.8	2.5
2048	Prepared feeds, not elsewhere classified	43.7	4.2
2079	Shortening and cooking oils	30.4	2.9
2099	Food preparations, not elsewhere classified	32.7	3.1
2077	Animal and marine fats and oils	32.9	3.1
2022	Cheese, natural and processed	21.8	2.1
2023	Condensed and evaporated milk	23.9	2.3
2032	Canned specialties	21.7	2.1
2086	Bottled and canned soft drinks	30.3	2.9
2016	Poultry dressing plants	14.5	1.4
2085	Distilled liquor	21.4	2.0
2013	Sausage and prepared meats	21.2	2.0
2047	Pet food	12.8	1.2
2061	Raw cane sugar	14.3	1.4
2065	Confectionery products	18.2	1.7
2038	Frozen specialties	12.2	1.2
2041	Flour and other grain mill products	13.8	1.3
2034	Dehydrated food products	10.0	1.0
2052	Cookies and crackers	13.3	1.3
2095	Roasted coffee	14.2	1.4
2083	Malt	9.4	.9
2043	Cereal breakfast foods	8.3	.8
2074	Cottonseed oil mills	7.0	.7
2035	Pickles, dressings, and sauces	7.5	.7
2024	Ice cream and frozen desserts	6.1	.6
2021	Creamery butter	8.5	.8
2066	Chocolate and cocoa products	5.1	.5
2087	Flavoring extracts and sirups, not elsewhere classified	7.9	.8
2017	Poultry and egg processing	4.4	.4
2091	Canned and cured seafood	5.3	.5
2084	Wines, brandy	2.5	.3
2092	Fresh or frozen packaged fish	3.7	.4
2076	Vegetable oil mills, not elsewhere classified	4.1	.4
2044	Rice milling	2.4	.2
2097	Manufactured ice	3.2	.3
2098	Macaroni and spaghetti	2.4	.2
2045	Blended and prepared flour	2.5	.2
2067	Chewing gum	1.2	.1

Energy sources for SIC 20 were as follows in 1972:

Form of energy	10^{12} Btu	Percent of total
Fuel oil	188.1	18.1
Natural gas	628.1	60.0
Coal, coke, breeze	114.1	10.9
Electricity	126.7	12.1
Other	18.9	1.9
Total	1,046.9	100.0

The 47 industry components making up SIC 20 are described as follows:

Meat packing plants, SIC 2011, includes companies primarily engaged in slaughtering cattle, hogs, sheep, lambs, and calves for meat.

Sausages and other prepared meat products, SIC 2013, describes companies which manufacture sausages, cured meats, smoked meats, and other prepared meats and meat specialties, from purchased carcasses and other materials.

Poultry dressing plants, SIC 2016, includes companies which slaughter and dress poultry, rabbits, and other small game, for meat to be sold or used for further processing.

Poultry and egg processing, SIC 2017, describes companies which prepare processed poultry products from purchased carcasses or which are engaged in the drying, freezing, and breaking of eggs.

Creamery butter, SIC 2021, groups companies primarily engaged in manufacturing creamery butter.

Cheese, natural and processed, SIC 2022, includes manufactures of all types of natural cheese (except cottage cheese), processed cheese, cheese foods, and cheese spreads.

Condensed and evaporated milk, SIC 2023, describes companies which make condensed and evaporated milk and related products, including ice cream mix and ice milk made for sale as such, and dry milk products. Also included is the manufacture of nondairy-base cream substitutes and dietary supplements.

Ice cream and frozen desserts, SIC 2024, includes manufactures of ice cream and other frozen desserts such as ice milk and sherbets.

Fluid milk, SIC 2026, groups companies primarily engaged in processing and distributing milk and cream, and related products including cottage cheese.

Canned specialties, SIC 2032, describes companies which can specialty products such as baby foods, health foods, and soups except seafood.

Canned fruits, vegetables, preserves, jams, and jellies, SIC 2033, groups companies which can fruits and vegetables, and fruit and vegetable juices, or manufacture catsup and similar tomato sauces, preserves, jams, and jellies.

Dried and dehydrated fruits, vegetables, and soup mixes, SIC 2034, includes companies which sun dry or artificially dehydrate fruits and vegetables, or which manufacture packaged soup mixes from dehydrated ingredients.

Pickled fruits and vegetables, vegetable sauces and seasonings, and salad dressings, SIC 2035, describes companies engaged in pickling and brining fruits and vegetables, and in manufacturing salad dressings, vegetable relishes, sauces, and seasonings.

Frozen fruits, fruit juices and vegetables, SIC 2037, includes companies which freeze and cold pack fruits, fruit juices, and vegetables.

Frozen specialties, SIC 2038, includes companies which freeze and cold pack food specialties, such as frozen dinners and frozen pizza.

Flour and other grain mill products, SIC 2041, describes companies engaged in milling flour or meal from grain, except rice.

Cereal breakfast foods, SIC 2043, includes companies which manufacture cereal breakfast foods and related preparations.

Rice milling, SIC 2044, describes companies which clean and polish rice, and companies which manufacture rice flour or meal.

Blended and prepared flour, SIC 2045, includes companies which prepare blended flours and flour mixes or doughs from purchased flour.

Wet corn milling, SIC 2046, includes companies which mill corn or sorghum grain by the wet process, and produce starch, syrup, oil, sugar, and byproducts, such as gluten feed and meal.

Dog, cat and other pet food, SIC 2047, includes manufactures of pet food from cereal, meat, and other ingredients.

Prepared feeds and feed ingredients for animals and fowls, not elsewhere classified, SIC 2048, describes companies which manufacture prepared feeds and feed ingredients and adjuncts for animals and fowls.

Breads and other bakery products, except cookies and crackers, SIC 2051, includes those companies which manufacture bread, cakes, and other "perishable" bakery products.

Cookies and crackers, SIC 2052, describes companies which make cookies, crackers, pretzels, and similar dry bakery products.

Cane sugar, except refining only, SIC 2061, includes manufacturers of raw sugar, syrup, or finished cane sugar from sugar cane.

Cane sugar refining, SIC 2062, describes companies primarily engaged in refining purchased raw cane sugar and sugar syrup.

Beet sugar, SIC 2063, includes companies primarily engaged in manufacturing sugar from sugar beets.

Candy and other confectionary products, SIC 2065, includes companies which make candy, including chocolate candy (except

solid bars) salted nuts, other confections and related products.

Chocolate and cocoa products, SIC 2066, describes companies which shell, roast, and grind cocoa beans to make chocolate liquor, cocoa powder, cocoa butter, solid chocolate bars and chocolate coatings.

Chewing gum, SIC 2067, describes companies which manufacture chewing gum or chewing gum base.

Cottonseed oil mills, SIC 2074, includes manufacturers of cottonseed oil, and byproduct cake, meal, and linters.

Soybean oil mills, SIC 2075, includes manufacturers of soybean oil, and byproduct cake and meal.

Vegetable oil mills, except corn, cottonseed, and soybean, SIC 2076, includes companies which manufacture vegetable oils and byproduct cake and meal, except corn, cottonseed, and soybean. This classification includes castor oil, coconut oil, linseed oil and peanut oil.

Animal and marine fats and oils, SIC 2077, describes companies which manufacture animal and marine oils and those rendering inedible grease and tallow from animal fat, bones, and meat scraps.

Shortening, table oils, margarine and other edible fats and oils, not elsewhere classified, SIC 2079, includes manufacturers of shortening, table oils, etc. by further processing of purchased animal and vegetable oils.

Malt beverages, SIC 2082, describes manufacturers of all kinds of malt beverages including beer, ale, and malt liquor.

Malt, SIC 2083, describes companies which manufacture malt or malt byproducts from barley or other grains.

Wines, brandy, and brandy spirits, SIC 2084, describes manufacturers of these spirits and bonded storerooms which blend wines.

Distilled, rectified, and blended liquors, SIC 2085, includes companies which manufacture alcoholic liquors, cordials, and alcoholic cocktails by blending processes or by mixing liquors and other ingredients.

Bottled and canned soft drinks and carbonated waters, SIC 2086, includes companies which make soft drinks and carbonated waters (nonalcoholic).

Flavoring extracts and flavoring syrups, not elsewhere classified, SIC 2087, describes manufacturers of flavorings for soda fountain use or for the manufacture of soft drinks.

Canned and cured fish and seafoods, SIC 2091, includes companies primarily engaged in cooking and canning fish, shrimp, oysters, clams, crabs, and other seafoods, including soups, and those engaged in smoking, salting, drying or otherwise curing fish for the trade.

Roasted coffee, SIC 2095, describes companies which roast coffee and those which make coffee concentrates and extracts.

Manufactured ice, SIC 2097, describes companies primarily engaged in manufacturing ice for sale.

Macaroni, spaghetti vermicelli, and noodles, SIC 2098, includes companies manufacturing dry macaroni, spaghetti, vermicelli, and noodles.

Food preparations, not elsewhere classified, SIC 2099, includes companies primarily engaged in manufacturing prepared foods and miscellaneous food specialties, not elsewhere classified, such as baking powder, yeast, peanut butter, tea, spices, and potato chips.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

Each component industry was approached on a composite basis as distinct from a model plant approach. Since most of the data available were on a plant specific or technique specific basis, it was necessary to rely on expert judgment and information from a number of professional sources.

A. *Technological Feasibility.* Five criteria were developed to measure technological feasibility. An affirmative answer to each of the following questions was necessary for each potential conservation measure to pass this screening.

1. Is it commercially available?
2. Can it be widely installed by January 1, 1980?
3. Can it be used without significant changes in industry or plant product mix?
4. Can it be introduced without significant losses in processing plant production?
5. Can it meet requirements of federal and State standards for both products and production processes?

B. *Economic Practicability.* For each measure that passed the technological screening, an economic assessment was made to determine economic viability. An after-tax discounted cash flow return on investment method was used to establish economic viability. This involved computing the internal rate of return at which the annual equivalent cost of each energy efficiency improvement measure was equal to the annual energy cost savings. The degree of viability of the measure for the composite industry was obtained by estimating the probability that the rate of return for each measure would be greater than or equal to the four-digit component industry's cost of capital, where the component industry's rate of return was described by a distribution.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

A. *Required Return on Investment.* Capital availability is a constraining factor within the SIC 20 component industries, and available capital was found to be insufficient for all investments which had some probability of their internal rate of return being equal to or greater than the industry cost of capital. A sensitivity analysis, assuming unlimited capital at each industry's cost of capital was performed. In this hypothetical case, the gross target for SIC 20 was increased from 15 percent to 19 percent; this difference suggests that a sizeable target-related constraint exists due to capital limitations.

B. *Capital Spending Priorities.* Although a potential conservation measure may be economically viable, it may not be practicable for a particular firm because of other priorities for capital investment. Some firms may not be able to implement all available conservation measures because they have already allocated all available capital to more attractive investments, to mandatory investments for complying with Federal or State regulations or for manning production.

Replacement restraints may affect the allocation of capital. Some firms will not replace existing equipment to improve energy efficiency until the equipment's useful life has been utilized.

Third, the limited supply of selected conservation equipment reduces the degree of a conservation measure's implementation by 1980. Some measures (capital facilities and equipment) are likely to be unavailable on a supply schedule necessary to meet aggregate industry demands as implied in this study by 1980. If effective demand increases sharply, price increases would be expected, and these would also dampen the aggregate industry response to a given energy conservation measure. The assessment of these characteristics of SIC 20 was, at times, necessarily subjective, but the factors involved are well documented in the target support document.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

A full discussion of the examination of all potential energy conservation measures considered for application to each of the 47 component industries can be found in the target support documents which are available for examination at the locations and times specified in the body of this notice. This appendix will only discuss the major aspects of the assessment of potential energy conservation measures.

A. *Potential Measures Identified.* The major energy conservation measures considered for the food and kindred products industry were:

Waste Energy Recovery

1. Use waste heat from plant equipment (cookers, dryers, kilns, mechanical compressors).
2. Recover heat in waste service hot water.
3. Recover heating or cooling effect from ventilation exhaust air to precondition incoming ventilation air (e.g., use "heat wheel" or other heat exchanger to cross-exchange building exhaust air with make-up air).
4. Reduce building exhausts and thus make-up air or recycle air for heating, ventilation and air conditioning to maximum extent.
5. Increase regeneration in fluid heat/cooling recovery by increasing size of heat exchanger.
6. Use low temperature waste effluent to cool input streams.

Improve Electrical Energy Usage

1. Optimize plant power factors by (i) deenergizing excess transformer capacity, and (ii) installing capacitor banks to increase power factor.
2. Optimize motor sizes and pumps with loads to improve power factor and efficiency.
3. Use more efficient light sources, i.e., convert to fluorescent, mercury, sodium, or high intensity direct lighting.
4. Reduce or eliminate general lighting where natural light provides sufficient illumination. Limit higher lighting levels to task areas only.
5. Reduce general illumination to minimum necessary for safety.
6. Reduce exterior buildings and grounds illumination to minimum safe level.
7. Consider replacing electric motors with back pressure steam turbines and use exhaust steam for process heat.
8. Use multiple capacity compressors for refrigeration.

Increased Boiler and Steam Efficiency

1. Minimize boiler blowdown.
2. Use better feedwater treatment to reduce blowdown need.
3. Recover heat from hot blowdown.
4. Return more steam condensate to boiler.
5. Use flue gas heat to preheat boiler feedwater and combustion air.
6. Use waste heat from hot flue gases to generate low pressure steam or hot water.
7. Reduce combustion air flow to optimum and improve combustion control capability.
8. Install and repair steam traps.
9. Descale boiler tubes more frequently.
10. Insert turbulators or spinners in boilers to increase heat transfer to water.
11. Improve oil atomization (use compressed air rather than steam).
12. Better maintenance of burners and injection systems.
13. Minimize use of standby boilers or boilers operating at low power.

USE OF INSULATION

1. Insulate steam and condensate lines.
2. Upgrade insulation and linings in furnaces, boilers, kilns, ovens, cookers and other process equipment.
3. Insulate walls, ceilings, and roofs.

REFRIGERATION AND SPACE CONDITIONING

1. Maintain space temperature lower during the winter season and higher during the summer season.
2. Air condition only space in use.
3. Reduce air conditioning load by evaporating water from roof.
4. Shut-down air conditioning during nonworking hours.
5. Reduce heating level when building is not in use.
6. Use process waste heat for space heating.
7. Use double doors or curtains between heated and cooled areas.
8. Install air seals around truck loading dock doors.
9. Keep loading dock doors closed when not in use.

DRYERS, EVAPORATORS, AND OTHER PROCESS EQUIPMENT

1. Improve evaporator efficiency by installing additional effects.
2. Use mechanical vapor recompression in evaporation processes.
3. Use ring dryers rather than straight through dryers.
4. Use large screw and pneumatic presses to de-water product before drying.
5. Improve maintenance on heat transfer surfaces.
6. Minimize air intrusion into ovens and use of air fans.
7. Match air compressors to actual requirements.
8. Use microwave drying and cooking to eliminate long steam heating times.
9. Install agitators in vacuum pan of evaporators to improve heat transfer.

GENERAL ENERGY MANAGEMENT

1. Salvage and re-use process waste.
2. Use optimum sized equipment.
3. Use most efficient equipment at it's maximum capacity and less efficient equipment only when necessary.
4. Minimize operation of equipment required to be maintained in standby condition.
5. Shutdown process heating equipment when not in use, or at least reduce temperature of process heating equipment when on standby.
6. Reduce operating time of equipment to that actually required.
7. Use small number of hight output units instead of many small inefficient units.
8. Clean or replace filters regularly.
9. Convert from batch to continuous operation.
10. Convert from indirect to direct firing (e.g., ovens).
11. Convert liquid heaters from underfiring to immersion or submersion heating.
12. Replace steam use by high temp water-eliminate steam losses.

B. *Efforts to Reduce Consumption of Petroleum Products and Natural Gas.* Planned fuel shifts cause only a small impact, on the conservation target for SIC 20. Historically, many of the 47 food industries used coal as a major fuel. Most have long since converted to natural gas and fuel oils in response to the national concern over air pollution as well as to increased ease of operation. Government and industry standards for product quality accelerated the shift away from coal with its problems of soot and fly ash. Handling requirements, personnel requirements, and safety considerations would deter any reconversion to coal at this time.

Because of allocation and undependable supplies, many plants which had previously converted to natural gas are shifting to the use of fuel oils. Although this shift substitutes oil which is becoming scarce worldwide for domestically scarce natural gas, the trend is continuing. The general availability of fuel oils albeit at relatively higher prices deters any significant moves toward the use of more abundant fuels such as coal.

V. PROPOSED TARGET DEFINITION

A. *Component Goals.* The evaluations and calculations detailed in the target support documents resulted in energy efficiency component goals for each of the four-digit components of SIC 20 as shown in Table 1.

B. *Proposed Two-Digit Gross Target.* The SIC 20, food and kindered products industry, proposed energy efficiency improvement target was determined from the 47 component goals. The procedure used for aggregating the component goals involved an energy weighting process as follows:

$$T = \frac{\sum_{i=1}^{47} E_i^{72} - \sum_{i=1}^{47} E_i^{80}}{\sum_{i=1}^{47} E_i^{72}}$$

where

T = 1980 energy efficiency improvement target
$\sum$ = indicates a summation over all 47 component industries,
E_i^{72} = 1980 energy consumption using 1972 efficiency for each 4 digit industry i, $i = 1, 2, 3, * * *, 47$,
E_i^{80} = 1980 energy consumption using 1980 efficiency (1972 efficiency less improvement goal) for each industry i.

The proposed gross target for SIC 20 was 15 percent.

C. *Special Circumstances Effect.* The remaining assessment involved the evaluation of those uncontrollable factors that could affect energy efficiency. Three special circumstances were identified for SIC 20: (1) Government regulations, (2) industry structure changes, and (3) product mix shifts. Government regulations were the most apparent factors that will alter the energy consumption of the food industries. For example, the air and water environmental control programs of EPA, the employment safety and health regulations of OSHA, and the food and drug standards of FDA are of widespread concern to the food industries. Implementation of these regulations is frequently costly and generally does reduce an industry's energy efficiency per unit of production. While industry structure changes and product mix shifts influence energy use, there generally was inadequate data available to quantify the energy efficiency impacts of these factors for the 1972–1980 period. The impact of special circumstances on each component industry was estimated as shown in Table I.

TABLE I.—*Proposed energy efficiency improvement goals for SIC 20 components*

SIC	Industry (1972 codes)	Rank order [1]	Gross goal	Adjustment	Net goal
20	Food and kindred products		15	1	14
Priority group I:					
2063	Beet sugar	1	23	2	21
2046	Wet corn milling	2	8	1	7
2011	Meat packing plants	3	13	1	12
2082	Malt beverages	4	8	1	7
2033	Canned fruits and vegetables	5	12	1	11
2026	Fluid milk	6	16	1	15
2051	Bread, cake and related products	7	19		19
2075	Soybean oil mills	8	18	1	17
2062	Cane sugar	9	14	1	13
2037	Frozen fruits and vegetables	10	12	1	11
2048–A	Prepared feeds, not elsewhere classified	11	27	1	26
2048–B	Prepared feeds, alfalfa	11	24	1	23
Priority group II:					
2079	Shortening and cooking oils	12	14		14
2099	Food preparations, not elsewhere classified	13	15	1	14
2077–A	Animal and marine fats and oils, animal	14	12	1	11
2077–B	Animal and marine fats and oils, marine	14	9	1	8
2022	Cheese, natural and processed	15	11	1	10
2023	Condensed and evaporated milk	16	11	1	10
2032	Canned specialities	17	12	1	11
2086	Bottled and canned soft drinks	18	15	1	14
2016	Poultry dressing plants	19	15	1	14
2085	Distilled liquor	20	12	1	11
2013	Sausage and prepared meats	21	11		11
2047–A	Pet food, canned	22	14		14
2047–B	Pet food, dry	22	22	1	21
2061	Raw cane sugar	23	21	1	20
2065	Confectionery products	24	22		22
2038	Frozen specialties	25	13	1	12
2041	Flour and other grain mill products	26	8		8
2034	Dehydrated food products	27	11		11
2052	Cookies and crackers	28	19		19
Priority group III:					
2095	Roasted coffee	29	7	1	6
2083	Malt	30	9	1	8
2043	Cereal preparations	31	16		16
2074	Cottonseed oil mills	32	19	1	18
2035	Pickles, dressings and sauces	33	11		11
2024	Ice cream and frozen desserts	34	18	1	17
2021	Creamery butter	35	12	1	11
2066	Chocolate and cocoa products	36	19		19
2087	Flavoring extracts and syrups, not elsewhere classified	37	14	1	13
2017	Poultry and egg processing	38	13		13

SIC	Industry (1972 codes)	Rank order [1]	Gross goal	Adjustment	Net goal
2091	Canned and cured seafood	39	12	2	10
2084	Wines, brandy	40	16	1	15
2092	Fresh or frozen packaged fish	41	14	3	11
2076	Vegetable oil mills, not elsewhere classified.	42	16		16
2044	Rice milling	43	8		8
2097	Manufactured ice	44	15		15
2098	Macaroni and spaghetti	45	8		8
2045	Blended and prepared flour	46	9		9
2067	Chewing gum	47	12		12

[1] The 47 component industries are ranked according to their 1974 total energy consumption and subdivided into 3 priority groups indicative of their energy consumption relative to the entire SIC 20 industry.

D. *Proposed Two-Digit Net Target.* Proposed net goals were derived for each component by subtracting the total component adjustments due to the effect of special circumstances from the respective proposed gross goal as shown in Table 1. The proposed net target for SIC 20 was developed by using the formula given in V B for the proposed gross target and substituting the net component goals as developed above. The resulting proposed net energy efficiency improvement target was 14 percent.

VI. FINAL TARGET DEFINITION

A. *Comments and Impact on Proposed Target.* During the public hearings that were held on December 7 and 8, 1976, 10 oral statements were presented. In addition, 20 written statements were submitted. While some statements addressed specific component industries, other statements related to the total industry group. All of the oral and written comments have been thoroughly reviewed and their impact on the proposed target has been assessed. FEA's response to the comments is summarized here by issues raised.

Most reviewers expressed concern that either the target or individual component goal would be inappropriately applied to individual plants or companies. While the target for the SIC 20 industry group can be achieved on an industry wide basis by 1980, FEA recognizes that the potential for energy efficiency improvement varies within each component industry and on a plant-by-plant basis. The component goals only apply to each composite industry and are not meant to be applied to individual plants or individual companies.

FEA used 1972 as the base year to measure industry progress in improving energy efficiency. Several comments requested more flexibility in determining a base year because of the apparent difficulty in obtaining accurate consumption figures for 1972. FEA selected 1972 as the base year for measuring energy conservation efforts because it was the latest pre-embargo calendar year. Most of the present voluntary reporting programs use 1972 as their base year, and FEA will continue to use 1972 as the base year.

Several comments addressed the energy use patterns for various components. Certain modifications were suggested based on information provided by the industries themselves. After reviewing the information provided, FEA modified the energy use profiles of four components to increase the estimated percentage of energy provided by electricity by a range of one to six percent.

Several comments suggested that more energy conservation equipment was already in place in 1972 than indicated in the draft target support document for SIC 20. In addition, it was claimed that boiler efficiency was higher for some of the industry components than indicated. FEA has reviewed these claims and has made modifications in eight components where the information revealed that more energy efficiency equipment was in place in 1972 than had been initially estimated.

Many of the comments indicated that the technically achievable energy savings for various activities were higher in the draft target support document than could reasonably be achieved. After reviewing the information provided on the energy savings of specific conservation measures, FEA concludes that decreases in the estimated potential savings are warranted in eight components.

Nearly all of those testifying indicated that governmental regulations would require more energy than indicated by the special circumstances offset in the draft target support document. The proposed offsets were reexamined in light of the additional information provided and FEA has made adjustments in three components where it was felt that governmental regulations would have a greater impact on energy consumption than initially estimated. In each case the offset was increased by one percent.

While data on the effect of special circumstances on energy consumption in SIC 20 is limited, EPCA 374(d) allows for modifying the target value if FEA feels this is necessary in the future.

Statements from several industry groups indicated that in some cases the economically practicable coefficients discussed in the target support document were too high. After reviewing the data in the support documents, FEA made adjustment in two components. In one case the internal rates of return from savings achieved by installing improved equipment and new insulation, and converting to fluorescent lighting were adadjusted downward. In the other case, a very recent sharp drop in the price of the major product has virtually eliminated new capital investment over the foreseeable future.

Several comments indicated that uncontrollable climatic conditions could alter the energy use levels for components in any given year because varying moisture levels in raw products as a result of weather conditions will affect the amount of energy required to process the raw products. While FEA recognizes that raw product moisture levels and thus energy requirements may vary with climatic conditions, the proposed target was based on average moisture levels. The target may be modified, as allowed by EPCA 374(d), if future conditions warrant.

One comment stated that a portion of one component had been overlooked in developing the energy efficiency improvement goal for that component. The commentor provided information which showed that the ratio of boiler fuel to purchased electricity used by the industry was higher than estimated by FEA. Reexamination of the industry in view of the new information resulted in an increase of one percent in the component goal.

B. *Final Target.* As a result of the additional information received after the publication of the proposed targets the target values were modified. The final gross energy efficiency improvement target for the food and kindred products industry is 13 percent, and the final net energy efficiency improve-

ment target including special circumstances is 12 percent.

The following table displays the final component goals:

TABLE II.—*Final energy efficiency improvement targets for the food and kindred products industry and component goals for 1980*

SIC	Industry (1972 codes)	Rank order [1]	Gross goal	Adjustment	Net goal
20	Food and kindred products		13	1	12
Priority group I:					
2063	Beet sugar	1	8	2	6
2046	Wet corn milling	2	8	1	7
2011	Meat packing plants	3	13	1	12
2082	Malt beverages	4	7	1	6
2033	Canned fruits and vegetables	5	12	1	11
2026	Fluid milk	6	15	1	14
2051	Bread, cake and related products	7	19		19
2075	Soybean oil mills	8	17	1	16
2062	Cane sugar	9	14	2	12
2037	Frozen fruits and vegetables	10	12	1	11
2048-A	Prepared feeds, not elsewhere classified	11	17	1	16
2048-B	Prepared feeds, alfalfa	11	23	1	22
Priority group II:					
2079	Shortening and cooking oils	12	14		14
2099	Food preparations, not elsewhere classified.	13	15		14
2077-A	Animal and marine fats and oils, animal	14	12		11
2077-B	Animal and marine fats and oils, marine	14	9	1	8
2022	Cheese, natural and processed	15	11	1	10
2023	Condensed and evaporated milk	16	11	1	10
2032	Canned specialties	17	12	1	11
2086	Bottled and canned soft drinks	18	15	1	14
2016	Poultry dressing plants	19	15	1	14
2085	Distilled liquor	20	12	1	11
2013	Sausage and prepared meats	21	11	1	10
2047-A	Pet food, canned	22	14		14
2047-B	Pet food, dry	22	21	1	20
2061	Raw cane sugar	23	21	1	20
2065	Confectionery products	24	16		16
2038	Frozen specialties	25	13	1	12
2041	Flour and other grain mill products	26	8		8
2034	Dehydrated food products	27	11		11
2052	Cookies and crackers	28	14		14
Priority group III:					
2095	Roasted coffee	29	7	1	6
2083	Malt	30	9	1	8
2043	Cereal preparations	31	16		16
2074	Cottonseed oil mills	32	19	1	18
2035	Pickles dressings and sauces	33	11		11
2024	Ice cream and frozen desserts	34	17	1	16
2021	Creamery butter	35	12	1	11
2066	Chocolate and cocoa products	36	12	1	11
2087	Flavoring extracts and syrups, not elsewhere classified.	37	11	1	13
2017	Poultry and egg processing	38	12		12
2091	Canned and cured seafood	39	12	2	10
2084	Wines, brandy	40	16	1	15
2092	Fresh or frozen packaged fish	41	14	3	11
2076	Vegetable oil mills not elsewhere classified.	42	16		16
2044	Rice milling	43	8		8
2097	Manufactured ice	44	15		15
2098	Macaroni and spaghetti	45	8		8
2045	Blended and prepared flour	46	9		9
2067	Chewing gum	47	13		13

[1] The 47 component industries are ranked according to their 1974 total energy consumption and subdivided into 3 priority groups indicative of their energy consumption relative to the entire SIC 20 Industry.

The impact in 1980 of meeting the net target of 12% as compared to 1972 is as follows for SIC 20:

1972 total consumption = 1047×10^{12} Btu

1980 total consumption = 1052×10^{12} Btu (provided the target is attained)

The following is the energy efficiency improvement target set by FEA for SIC 20:

Gross target, based solely on technological feasibility and economic practicability—13 percent

Offset, based on consideration of special circumstances—1 percent

Net target, based on technological feasibility and economic practicability plus consideration of special circumstances—12 percent

APPENDIX B: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 22—TEXTILE MILL PRODUCTS

I. *Industry Description and Energy Base.* The textile mill products industry comprising Standard Industrial Classification (SIC) 22 consists of 30 four-digit product classifications. SIC 22 includes manufacturers and finishers of yarn, cordage, woven fabric, knit fabric, carpets and rugs.

Because the SIC often includes dissimilar processing techniques in one four-digit classification, these groupings were not appropriate for studying energy conservation in this industry. The following table describes the components that were used to analyze the textile mill industry and shows the energy consumption of each component in the base year, 1972:

Component	SIC	1972 energy consumed 10^9 kWh [1]	Percent
Spinning	Parts of—2211: Broadwoven fabric mills, cotton. 2221: Broadwoven fabric mills, man-made fiber and silk. 2281: Yarn spinning mills; cotton, man-made fibers and silk. 2282: Yarn texturizing, throwing, and winding mills. 2284: Thread mills.	10	7.2
Texturizing	Parts of 2221, 2281, 2282, 2284	8	5.8
Weaving	2241: Narrow fabrics and other smallwares mills 2211, 2221	8	5.8
Knitting	2257: Circular knit fabric mills. 2258: Warp knit fabric mills	1	0.7
Greige mills	Parts of 2211, 2221, 2257, 2258, 2281	7	5.0
Finishing, woven fabrics.	Parts of—2261: Finishers of broadwoven fabrics of cotton. 2262: Finishers of broadwoven fabrics of man-made fiber and silk. 2269: Finishers of textiles, not elsewhere classified.	48	34.5
Finishing, knitted fabrics.	Parts of 2257, 2258, 2261, 2262	19	13.7
Yarn dyeing	Parts of 2281, 2211, 2257, 2258	6	4.3
Floor coverings	2271: Woven carpets and rugs. 2272: Tufted carpets and rugs. 2279: Carpets and rugs, not elsewhere classified.	11	7.9
Secondary processes	2231: Broad woven fabric mills, wool. 2251: Women's full length and knee length hosiery. 2252: Hosiery, except women's full length and knee length hosiery. 2253: Knit outerwear mills. 2254: Knit underwear mills. 2259: Knitting mills, not elsewhere classified. 2283: Yarn mills, wool. 2291: Felt goods, except woven felts and hats. 2292: Lace goods. 2293: Paddings and upholstery filling. 2294: Processed waste and recovered fibers and flock. 2295: Coated fabrics, not rubberized. 2296: Tire cord and fabric. 2297: Nonwoven fabrics. 2298: Cordage and twine. 2299: Textile goods, not elsewhere classified.	21	15.1

[1] kWh=3,412 Btu.

Energy sources for SIC 22 were as follows in 1972:

Form of energy	10^9 kWh	Percent of total
Fuel oil	26.3	19
Coal	12.5	9
Natural gas	40.2	29
Electricity	33.3	24
Other	26.3	19
Total	138.6	100

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

Because of the short-term goal of this project, only procedures and technologies already in implementation at least at the bench scale were considered in developing the SIC 22 target. The feasibility of implementing the measures by 1980 was adjusted according to their current stage of development. Realistic rates of implementation were based on industry experts' knowledge.

A. *Technological feasibility.* Each potential measure was evaluated using the following general criteria:

1. Can the measure be implemented in time to have an impact on energy consumption by January 1, 1980?

2. Does the measure have an unacceptable impact on the finished prodct? (A very few energy conservation measures which may have marginally detrimental effects on quality were considered feasible. However, their limited applicability because of the lower quality fabric produced was accounted for in the development of the component goals and industry target.)

3. Does the measure conflict with or potentially hamper compliance with EPA or OSHA regulations?

4. Does the measure conflict with or overlap a measure planned for implementation in the early 1980's? (Some firms may forego the purchase of available equipment in anticipation of purchasing better equipment with a slightly longer lead time.)

B. *Economic practicability.* Each measure that satisfied the technological criteria was then evaluated for economic feasibility. The economic anlysis technique selected for this study was a modified life cycle cost analysis. The return on investment was determined by comparing the actual cash flow including depreciation, financing and taxes with initial cost in order to determine the yearly rate of return and the number of years required to pay back the capital investment.

The following assumptions were used in the analysis:

1. Tax rate—50 percent.
2. Interest rate—9 percent.
3. Depreciation rate—IRS schedule and the sum-of-the-years method of calculation were used.
4. Energy costs—Actual energy prices paid by the firms were used.

After capital costs, rate of return, and pay back periods were computed, the economically feasible set of measures was selected.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

The set of technically and economically feasible measures was further screened on the basis of capital availability of obtain the optimum affordable set upon which to determine the target. The results of the return on investment ROI analysis are outlined in this section (III–A) as is the treatment of capital availability (III–B).

A. *Required return on investments.* The economic analysis revealed that, for the textile industry, the current actual payback period for capital expenditures of all types is 5.6 years. This figure was used in evaluating the economic acceptability of energy conservation measures. Each measure requiring a capital expenditure greater than $15,000 was subjected to a return-on-investment analysis. Those measures yielding a payback period of less than 5.6 years were retained. Four technologies did not pass the return-on-investment test.

B. *Capital spending priorities.* An analysis of the financial position of the textile industry and a projection of its future performance were completed to determine if sufficient capital would be available to the industry to implement all of the feasible conservation measures. The analysis identified the approximate annual capital expenditures in the industry and the source of these funds.

As a result of the analysis, it was determined that even after non-discretionary investments, such as those required to meet current government mandated environmental and health and safety requirements, sufficient funds will be available for all of the identified technologically and economically feasible conservation measures. It was found that the capital necessary to implement all the energy conservation measures was less than 5% of current annual capital investments.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

This appendix will only discuss the major aspects of the assessment of potential energy conservation measures. A detailed treatment of all the potential measures which were considered can be found in the target support documents which are available for examination at the locations and times specified in the body of this notice.

A. *Potential measures identified.* Nineteen basic energy efficient technologies were identified for the following components of the textile mill products industry:

SPINNING

1. Open end spinning.

GREIGE MILLS

2. Open end spinning.

WOVEN FABRIC FINISHING

3. Convert singer burner to be adjustable to cloth width.
4. Use infrared predryer with improved burners which also adjust to cloth width.
5. Use combined infrared/hot flue predryer.
6. Use air-to-air heat exchanger on tenter.
7. Use water-to-water heat exchanger for bleach, dye, and wash wastewaters.

KNIT FABRIC FINISHING

8. Use infrared predryer with burners which are adjustable to cloth width.
9. Use combined infrared/hot flue predryer.
10. Use air-to-air heat exchanger.
11. Use water-to-water heat exchanger for bleach, dye, and wash wastewaters.

YARN DYEING

12. Use water-to-water heat exchanger to recover wastewater heat.

FLOOR COVERING

13. Install wastewater heat reclaiming system.
14. Install air-to-air heat recovery system for foam backing range.*
15. Install air-to-air heat recovery system for Kuster dryer.*
16. Install air-to-air heat exchanger for printer dryer section.*
17. Install air-to-air heat exchanger on printer steamer and dryer.*
18. Install air-to-water heat exchanger for dye becks, preheat boiler feed, and washdown water.
19. Low temperature dyeing.

In addition, numerous energy efficient operating procedures were identified for each of the ten industry components. These measures are identified in the target support document along with the estimated energy savings of each.

B. *Efforts to reduce consumption of petroleum products and natural gas.* Several textile manufacturing firms are converting from natural gas to oil, and a few textile firms are replacing gas and oil-fired boilers with coal-fired units. Because considerable lead time is required to install large, coal-fired boilers, the conversion to coal will have no impact on the 1980 energy conservation target.

V. PROPOSED TARGET DEFINITION

A. *Component goals.* Evaluations and screening judgments resulted in the following, gross energy efficiency improvement goals:

(Those measures marked with an asterisk (*) were considered but eliminated by the economic practicability analysis. No new technology measures were identified for the texturizing, weaving, knitting, or secondary process components.)

Component goals and gross target development

Component	(1) 1972 efficiency (kilowatt-hour per kilogram)	(2) Projected 1980 production (millions of kilogram)	(3) 1980 energy consumption using 1972 efficiency [1] (billion kilowatthour)	(4) Projected 1980 efficiency (kilowatt-hour per kilogram)	(5) Projected 1980 energy consumption (billion kilowatthour) [2]	(6) Component goals (percent)
Spinning	5.40	2,308	12.41	4.86	11.17	10
Texturing	4.85	2,144	10.40	4.21	9.03	13
Weaving	4.76	1,970	9.38	3.68	7.25	23
Knitting	1.75	1,090	1.91	1.29	1.41	26
Greige mills	9.07	965	8.98	7.86	7.56	15
Finishing, woven fabric	15.67	2,666	55.19	10.77	31.84	43
Finishing, knit fabric	20.71	1,090	25.67	13.68	14.91	34
Yarn dyeing	12.61	622	7.85	9.13	5.67	28
Floor coverings	11.43	1,113	12.72	8.19	9.12	28
Secondary processes	14.66	1,738	25.26	11.99	20.91	20
Totals			166.13		118.57	

$$\text{Target calculation} = \frac{166.13 - 118.57}{166.13} \times 100 = 29 \text{ pct}$$

[1] Col. 1×col. 2.
[2] Col. 4×col. 2.

B. *Proposed two-digit gross target.* The two-digit gross target for the SIC 22 industry was computed according to the following formula:

$$\frac{\sum(E_{72} \times P_{80}) - \sum(E_{80} \times P_{80})}{\sum(E_{72} \times P_{80})} \times 100$$

where:

E_{72} = the energy consumption per unit of production for each of the components in 1972.
E_{80} = the projected energy consumption per unit of production for each of the components as of Jan. 1, 1980.
P_{80} = the projected 1980 production for each of the components.

The industry target was computed as the change in energy consumption per unit of production for each of the components, weighted to account for production differences for the various components. This approach takes into account the processing of goods by several components of the industry without counting production twice. The resulting proposed gross target for SIC 22 was 29 percent.

C. *Special circumstances effect.* Special circumstances which might affect the energy consumption of the textile industry included air conditioning of some mills for product quality purposes, treatment of wastewater, and the removal of cotton dust from the air within certain mills. The energy required for each of these circumstances was calculated to decrease the conservation target.

Between 1972 and 1975, air conditioning has been installed in mills representing approximately 15 percent of the production capacity of the industry, resulting in increased energy consumption of approximately 3 percent of the 1972 consumption in spinning, weaving, and greige mills, or 0.91 billion kWh annually, based on 1980 production. It is anticipated that air conditioning will continue to be installed through 1980 at the same rate requiring 1.82 billion kWh per year more in 1980 than was consumed in 1972.

The annual energy use for wastewater treatment facilities required by EPA were estimated. However, additional facilities which might be required to comply with discharge limitations more stringent than the limitations promulgated by EPA were not considered. The energy use is approximately 0.7 billion kWh annually and approximately 70 percent of this is for pretreatment facilities with effluent subsequently discharged to municipal sewers.

Compliance with the Occupational Safety and Health Administration (OSHA) standard for cotton dust of 1.0 mg per m^3 has increased energy consumption since 1972. Energy consumption for the vacuum collection systems and associated increased air conditioning loads is estimated at 1.5 percent of the total 1972 energy consumption for the weaving, spinning, and greige mill categories. In terms of 1980 production, this amounts to 0.45 billion kWh per year.

Energy consumption due to special circumstances totaled 2.97 billion kWh per year. The distribution of the additional energy by industry component is:

Component:	*Billion kWh/yr.*
Spinning	0.92
Texturizing	----
Weaving	.70
Knitting	----
Greige mills	.65
Woven fabric finishing	.30
Knit fabric finishing	.20
Yarn dyeing	.10
Floor coverings	.10
Secondary processes	----
Total	2.97

The effect of special circumstances on each component goal and on the gross industry target is shown in the following table:

Net target development

Component	(1) 1972 efficiency (kilowatt-hour per kilogram)	(2) Projected 1980 production (millions of kilograms)	(3) 1980 energy consumption using 1972 efficiency [1] (billion kilowatt-hours)	(4) Projected 1980 efficiency (kilowatt-hour kilogram) per kilogram) Gross	(4) Net	(5) Projected 1980 energy consumption [2] (billion kilowatt-hours) Gross	(5) Net
Spinning	5.40	2,298	12.41	4.86	5.22	11.07	12.09
Texturizing	4.85	2,144	10.40	4.21	4.21	9.03	9.03
Weaving	4.76	1,970	9.38	3.68	3.96	7.25	7.95
Knitting	1.75	1,090	1.91	1.29	1.29	1.41	1.41
Greige mills	9.07	985	8.93	7.68	8.26	7.56	8.21
Finishing, woven fabric	18.67	2,956	55.19	10.77	10.87	31.84	32.14
Finishing, knit fabric	20.71	1,090	22.57	13.68	13.86	14.91	15.11
Yarn dyeing	11.81	622	7.35	9.12	9.28	5.67	5.77
Floor coverings	11.43	1,113	12.72	8.19	8.28	9.12	9.22
Secondary processes	14.66	1,728	25.26	11.96	11.96	20.61	20.61
Totals			166.12			118.57	121.54

Target calculation = $\frac{166.12-121.54}{166.12} \times 100 = 27$ percent

[1] Col. 1×col. 2.
[2] Col. 4×col. 2.

NOTE.—Conversion factor: 1 kWh=3,412 Btu; 1 kg=2.2 lb.

D. *Proposed two-digit net target.* The proposed net target for SIC 22 was developed in a similar manner to the proposed gross target but using the proposed component figures developed above. The proposed net target was 27 percent.

VI. FINAL TARGET DEFINITION

A. *Comments and impact on proposed target.* Testimony given at the November 22, 1976, public hearing conducted by FEA and timely written comments on the subject of proposed targets are treated here according to the subject of the comment.

Some comments expressed concern that some of the energy conservation technologies and operating procedures considered were redundant and that the applicability of some conservation measures estimated in the support document were erroneous. Specific information concerning these comments was supplied by one commenter. These comments were carefully considered. As a result of this review, FEA adjusted some of its conclusions concerning some energy conservation measures:

1. Several operating procedures were eliminated from the target calculation.

2. The estimated applicability of conservation measures was adjusted to eliminate redundancies.

3. The degree of implementation for some operating procedures was adjusted.

4. The "net energy savings (kWh/kg)" attributable to some operating procedures were reduced.

The incorporation of these changes more accurately reflects the energy savings potential in the industry. Inclusion of these changes reduced the energy conservation target.

Comment from one source suggested that the special circumstances offset for energy consumption to treat wastewater was insufficient. The commenter pointed out that some textile mills are required to meet state effluent limitations which are stricter than those imposed by EPA. FEA acknowledges that an additional energy allowance should be provided to meet more stringent wastewater treatment requirements imposed by some states. In order to meet these requirements, the energy consumption needed for wastewater treatment was increased by 14 percent or 0.10 billion kWh/yr to 0.80 billion kWh/yr.

Other comments questioned the availability of qualified personnel, especially engineers, needed to identify energy savings opportunities and to apply conservation technologies and procedures which were assumed in the support document. This situation, while a problem, is difficult to quantify. In any event, FEA has added an additional factor to the special circumstances offset the textile industry to account for the lack of qualified energy conservation personnel. This factor will reduce the industry energy conservation target by 1 percentage point, which is equivalent to 1.2 billion kWh/yr.

Two comments objected to some suggested energy conservation technologies that they felt would not meet investment criteria in use in the industry. While the economic analysis of the textile industry indicated an average actual payback period of 5.6 years on capital investments of all types, industry spokesmen reported a desired payback period of from one to three years. FEA concludes that while this is the desired return-on-investment, the actual payback period is determined to be 5.6 years in the textile industry. Energy conservation measures meeting this 5.6 year payback period were included in the final target. A sensitivity analysis concluded that if the shorter payback period was used, the energy conservation target would decrease two percentage points.

Two commenters questioned the definition of 100 percent capacity utilization in the target support document and disagreed with the relationship between capacity utilization and energy efficiency used in the target sensitivity analysis. No additional data or information were, however, provided. After reviewing the support documents, FEA acknowledges that the description of .100 percent capacity utilization was inaccurate. FEA also agrees that the relationships between capacity utilization and energy efficiency in the textile industry are not known with sufficient accuracy to allow a sensitivity analysis of the target with respect to capacity utilization. The effect of capacity utilization changes on energy efficiency can be evaluated in the future and the target can be modified if necessary.

B. *Final target.* As a result of the evaluation of public comments and other information available to FEA, FEA modified the gross target for SIC 22 from 29 percent to 25 percent.

In addition, FEA has recognized the need to add the effect of special circumstances. Additional energy consumption to meet stricter wastewater treatment requirements and a correction factor for a shortage of qualified energy conservation personnel have resulted in an increase in the total offset factor from 2.97 billion kWh/yr to 4.27 billion kWh/yr.

The following table displays the proposed component goals and the final goals to illustrate the changes made.

Component	Proposed goals Gross (percent)	Proposed goals Net (percent)	Final goals Gross (percent)	Final goals Net (percent)
Spinning	10	3	9	0
Texturizing	13	13	10	9
Weaving	23	15	20	12
Knitting	26	26	20	13
Greige mills	15	8	13	5
Finishing, woven fabric	42	42	36	36
Finishing, knit fabric	34	33	26	25
Yarn dyeing	25	21	20	17
Floor coverings	28	28	26	25
Secondary processes	30	27	21	20
Textile industry	29	27	25	22

The following table shows the industry component values used in developing the final targets.

Final target development (gross and net)

Component	(1) 1972 energy/production (kilowatthour per kilogram)	(2) Projected 1980 production (millions of kilograms)	(3) 1980 energy consumption using 1972 efficiency [1] (billion kilowatthours)	(4) Projected 1980 energy/production (millions of kilograms) Gross	(4) Net	(5) Projected 1980 energy/consumption [2] (billion kilowatthours) Gross	(5) Net
Spinning	5.40	[illegible]	12.41	4.92	5.39	11.31	[illegible]
Texturizing	4.85	2,144	10.40	4.37	4.42	9.37	9.47
Weaving	47.6	1,970	[illegible]	[illegible]	[illegible]	7.53	8.28
Knitting	1.75	1,090	1.91	1.39	1.52	1.51	1.66
Greige mills	9.07	985	[illegible]	7.88	8.64	7.76	8.51
Finishing, woven fabric	13.67	[illegible]	15.10	11.91	[illegible]	35.21	35.71
Finishing, knit fabric	20.71	1,090	[illegible]	15.24	15.61	16.61	17.01
Yarn dyeing	11.81	622	7.35	9.43	9.76	5.87	6.07
Floor coverings	11.43	1,113	12.72	[illegible]	[illegible]	9.37	9.57
Secondary processes	14.06	1,723	[illegible]	11.64	11.73	20.06	20.21
Totals			166.12			124.60	128.87

Net target calculation $= \frac{166.12 - 128.87}{166.12} \times 100 = 22$ pct

Gross target calculation $= \frac{166.12 - 124.60}{166.12} \times 100 = 25$ pct

[1] Col. 1×col. 2.
[2] Col. 4×col. 2.

NOTE.—Conversion factor: 1 kWh=3,412 Btu; 1 kg=2.2 lb.

The impact of attainment of the net target on the industry's total energy consumption in 1980 as compared to 1972 is as follows for SIC 22:

1972 Total Consumption $= 139 \times 10^9$ kWh
1980 Total Consumption $= 129 \times 10^9$ kWh (provided the target is attained)

The following is the energy efficiency improvement target set by FEA for SIC 22:

	Percent
Gross target, based solely on technological feasibility and economic practicability	25
Offset, based on consideration of special circumstances	3
Net target, based on technological feasibility and economic practicability plus consideration of special circumstances	22

APPENDIX C: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 26—PAPER AND ALLIED PRODUCTS

I. INDUSTRY DESCRIPTION AND ENERGY BASE

The paper and allied products industry, Standard Industrial Classification (SIC) 26, is a grouping of 17 four-digit product classifications. The following descriptions of the four-digit classifications are from the SIC Manual, 1972 edition, in an abbreviated form:

SIC

2611 Pulp Mills—Primarily manufacturing pulp from wood or from other materials such as rags, wastepaper, and straw.

2621 Paper Mills, Except Building Paper Mills—Establishments primarily engaged in manufacturing paper except building papers.

2631 Paperboard Mills—Primarily engaged in manufacture of paperboard from wood pulp and other fibers.

2641 Paper Coating and Glazing—Manufacture of coated, glazed or varnished paper from purchased paper.

2642 Envelopes—Manufacture of envelopes of any description from purchased paper and paperboard.

2643 Bags—Manufacture of bags from purchased paper, cellophane, acetate, polyethylene, polypropylene, pliofilm and foil.

2645 Die-Cut Paper and Paperboard and Cardboard—Engaged in die cutting purchased paper and paperboard; and in manufacture of cardboard by laminating, lining or surface coating.

2646 Pressed and Molded Pulp Goods—Manufacture of pressed and molded pulp goods such as papermache.

2647 Sanitary Paper Products—Manufacture from purchased paper, sanitary paper products such as facial tissues, napkins, etc.

2648 Stationery, Tablets and Related Products—Manufacture of stationery, tablets, looseleaf fillers, etc., from purchased paper.

2649 Converted Paper and Paper Products, N.E.C.—Other paper and paperboard products not elsewhere classified. For example, gift wraps, wallpaper, crepe paper.

2651 Folding Paperboard Boxes—Manufacture of folding paperboard boxes from purchased paperboard.

2652 Set-up Paperboard Boxes—Manufacture of boxes from purchased paperboard such as filing boxes.

2653 Corrugated and Solid Fiber Boxes—Boxes manuafctured from purchased paperboard or fiber stock such as shipping hampers, display items, corrugated boxes.

2654 Sanitary Food Containers—Manufacture of food containers from special food board such as milk containers, paraffined cartons, paper cup, etc.

2655 Fiber Cans, Tubes, Drums, and Similar Products—Manufacture of cans, drums, etc., from purchased materials.

2661 Building Paper and Building Board Mills—Establishments primarily engaged in manufacture of building paper and building board from wood pulp and other fibrous materials.

For the purposes of analyzing the effect of potential conservation measures on energy consumption by SIC 26, the industry was divided into two sectors. The primary sector which accounts for over 90 percent of energy consumption by SIC 26 consists of firms involved in producing pulp, paper, paperboard and building paper at chemical process plants While the primary sector has far fewer members, it was the focus of the industry study because of its dominating energy consumption.

The secondary sector consists of companies involved in fabricating purchased paper into commercial paper products. Because some firms in the primary sector also have facilities to produce final paper products, it is difficult to determine an accurate allocation of energy expenditures between the two sectors.

Energy consumption by SIC 26 during the base year 1972 is shown in Table 1:

TABLE 1

Fossil fuels and purchased energy	Percent	1972 fossil fuels and purchased energy (Btu×10¹⁵)	1972 waste material and self-generated (Btu×10¹⁵)	1972 total energy consumption totals (Btu×10¹⁵)
PRIMARY SECTOR				
Fuel oils	38.9	0.501		
Natural gas	34.9	.449		
Coal	18.0	.232		
Liquid propane	.2	.002		
Purchased steam	1.3	.018		
Purchased electricity	6.7	.086		
Energy sold		−(.015)		
Primary subtotals	100.0	1.273	0.923	2.196
SECONDARY SECTOR				
All forms	(1)	.115	.009	.124
Totals		1.388	.932	2.320

[1] Valid data not available.

As Table 1 shows, waste materials produced during manufacturing paper accounted for about 42 percent of energy consumption in the primary sector and directly contributed to the conservation of fossil fuels and purchased energy. Any measurement of the energy contribution from burning waste material is imprecise due to the lack of process equipment (i) to meter the quantities of waste material being fed to boilers and (ii) to determine the moisture content of the waste material which affects the heating value of waste material. To determine the energy contribution of waste products to the total energy consumption in SIC 26, several calculations and estimates had to be made. First, the quantity of steam produced by burning waste materials is converted by engineering tables to available Btu's. Then an estimated combustion efficiency for spent liquor chemical recovery units and bark-burning boilers is divided into Btu's of steam produced in each unit giving approximate Btu's of waste materials burned in each. This calculation unfortunately is imprecise.

Proposed efficiency improvement targets were developed in terms of fossil fuels and purchased energy as well as in terms of total energy consumption including burning waste materials, but only the target developed on the basis of total energy consumption was proposed by FEA. As a result of the comments to the proposed target and additional field survey work, as discussed in section A of Part VI of this appendix FEA concluded that the most appropriate and useful basis for the final target is fossil fuels and purchased energy.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

A. *Technological feasibility.* The technological feasibility of each alternative operating procedure and more efficient technology was screened to determine conformity with the following standards.

(1) The measure must be capable of implementation by January 1, 1980.

(2) It must be in operation with a reasonable level of acceptance by the industry.

(3) It would not create adverse environmental effects.

(4) It would have a significant impact on the target for the industry.

(5) It could be installed and operated given the availability of manpower and equipment.

(6) It must provide net energy savings to the mill.

(7) It would not adversely affect product characteristics.

(8) It must be based on fuel availability where relevant.

B. *Economic practicability.* Those potential conservation measures that survived the technological feasibility screening were then judged for economic practicability.

Evaluation of prospective investments in distinct energy conserving measures involves two considerations.

First, the rate of return on investment (ROI) must be calculated to determine whether the return on an individual conservation measure exceeds the cost of obtaining funds to implement it, and to allocate available funds to the most effective investment alternatives. For this purpose, rate of return on investment (ROI) is defined as the discounted cash flow after taxes. This was calculated on a 10 percent investment tax credit, 48 percent corporate income tax, 10 year equipment life, a sum of the year's digit depreciation schedule, and operating cost of 7.5 percent of capital cost. The cost of capital was projected at 9.5 percent. The second consideration involved in the evaluation is the availability of capital for investment purposes. The extent to which funds are available will affect how much energy conservation is implemented. In assessing capital availability, the three major sources must be reviewed individually. Funds may be obtained from internally generated cash flows, from borrowings, or from equity financing efforts.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

A. *Required return on investment.* The economic situation of the paper industry was analyzed, using data from sources such as FEA, the American Paper Institute (API), Bureau of Census, Federal Trade Commission, U.S. Office of Management and Budget, American Newspaper Publishers Association (ANPA), Ford, Bacon & Davis, and the URS Research Co. study made for the API in September 1975. In addition, discussions were held with the management personnel of API, leading banks, investment firms and paper companies and their views were assessed in the supporting analyses of past and future investment trends in the paper industry.

In the initial screening, a hurdle rate is set to establish a minimum rate of return required of any potential investment to justify further consideration. In the paper industry a 15 percent ROI approximates recent returns on equity and was used as the hurdle rate. By contrast, the ROI's cited by industry are higher than this hurdle rate at this time because available funds for investment fall short of profitable investment opportunities. The 30 to 50 percent ROI cited as company experience reflect ROI for actual proposed projects at the cut-off point where available funds are exhausted.

B. *Capital spending priorities.* The economic practicability of potential conservation measures depends on the availability of capital. A return on investment over 15 percent does not automatically determine the economic practicability of a measure.

In establishing the capital availability for the paper and allied products industry over the period 1976–1979, a projection of the consumption and production of paper in the United States was prepared, and this became the basis for much of the following analysis. Several existing studies point up the need for additional capital funds in the industry in order to satisfy the requirements for pollution control equipment, plant expansion, and the purchase of timberlands. These are non-discretionary uses of funds which must be met before investment in conservation measures will be considered, but the constant increases in the cost of energy made the conservation measures attractive as an investment.

Reference to the Cash Flow Statement, Table 2, shows that after providing funds for capital requirements including working capital, property and plant and other investments, no internally generated capital exists for purely energy conserving installations.

The paper industry Cash Flow Statement for the period 1976–1979 shows a capital deficiency for energy conservation measures for the years 1976, 1977, and 1978. Internally generated funds are estimated at $20.8 billion less $6.7 billion for dividend payments and debt retirements. The net funds available for investment purposes is $14.1 billion.

Capital requirements consist of six major items:

1. Additions to working capital.
2. Acquiring timberlands.
3. Pollution control measures.
4. Plant and equipment investments to maintain and expand production in primary pulp and paper facilities.
5. Plant and equipment investments in converting, or sector II facilities.
6. Other investments.

Total capital requirements for these purposes are estimated at $21.0 billion for the paper industry. This leaves an external financial support requirement of $6.9 billion. However, additional long-term debt is limited to $5.9 billion and new equity to $1.0 billion totalling $6.9 billion. Therefore, the net capital deficiency is zero for this period. Given the financial and operating constraints on U.S. business enterprises, funds will not be available for distinct energy conservation measures until perhaps 1979. Capital funds for discretionary spending have been largely usurped by the need to provide funds for plant and equipment to meet anticipated greater product demands. However, a certain amount of energy conservation will be inherent in investments made to expand production to meet increased demand. These new facilities undoubtedly will include new and more energy efficient designs.

TABLE 2.—*Paper and allied products industry cash flow statement (in billions of dollars)*

	1976	1977	1978	1979	Total
1. Internal generation of funds:					
(a) Income after taxes	2.6	2.9	3.3	3.5	12.3
(b) Depreciation and depletion	1.3	1.5	1.8	1.9	6.5
(c) Deferred income taxes	.4	.5	.5	.6	2.0
Total internal generation	4.3	4.9	5.6	6.0	20.8
2. Capital paybacks:					
(a) Dividend payments	.9	1.0	1.2	1.2	4.3
(b) Debt retirement	.5	.6	.6	.7	2.4
Total	1.4	1.6	1.8	1.9	6.7
3. Funds available for industry purposes	2.9	3.3	3.8	4.1	14.1
4. Capital requirements:					
(a) Working capital additions	1.2	1.0	1.0	.7	3.9
(b) Property and plant:					
(1) Timberlands	.3	.9	.8	.2	2.2
(2) Plant-pollution control	.5	.7	1.1	1.6	3.9
(3) Plant-primary facilities	1.2	1.9	1.3	1.4	5.8
(4) Plant-converting facilities	.6	1.5	1.8	.4	4.3
Subtotal	2.6	5.0	5.0	3.6	16.2
(c) Other investments	.2	.2	.2	.3	.9
Total capital requirements	4.0	6.2	6.2	4.6	21.0
5. Funds required from external sources	1.1	2.9	2.4	.5	6.9
6. Supplied by:					
(a) Additional long-term debt	1.0	1.6	1.5	1.8	5.9
(b) New equity		.5		.5	1.0
Total supplied	1.0	2.1	1.5	2.3	6.9
7. Additional capital required before energy conservation retrofit measures quality	.1	.8	.9	(1.8)	0

IV. ASSESSMENT OF POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

A full discussion of all potential conservation measures considered can be found in the target support documents which are available for examination at the locations and times specified in the body of this notice. This appendix will discuss only the major aspects.

A. *Potential measures identified.* The following list of potential energy conservation measures which were screened for technological feasibility and economic practicability were selected from lists prepared by technical committees in trade associations related to the industry, the Canadian Pulp and Paper Industry Energy Conservation Program and interested industry members:

1. Automatic control of digesters by computers.

2. Control of combustion efficiencies in lime kilns with oxygen analyzers and other instruments.

3. Addition of a flash dryer between the lime mud filters and the kiln that follows to increase the mud feed solids to the kiln.

4. Addition of boiler flue gas waste heat recovery equipment.

5. Optimize boiler combustion controls.

6. Improve boiler feedwater heating with waste heat streams.

7. Computer control of paper machines.

8. Optimize paper machine dryer section hood system.

9. Reuse machine room mezzanine level air for paper machine hood supply and for building ceiling ventilation instead of outside air which has to be heated to above 200° F for the hood and to about 110° F for under the roof.

10. Counter-current washing in mills constructed with materials in bleach stages that will withstand corrosive chemicals.

11. Addition of computer controls to pulp bleaching operations.

12. Reuse water from paper machine save-all system (filter system to remove paper fibers from process water).

13. Use of variable speed fan pump drives (pumps which deliver the pulp/water mixture to the paper machine).

14. Optimize press efficiency by utilization of a wet end moisture gauge.

15. Use any available low pressure steam in the first dryer group.

Each of the above measures contributed to the proposed target value.

The following measures were not considered to be economically practicable and were not included in the target value.

1. Recover heat from reburned lime which is discharged from the kiln at about 2,000° F.

2. Utilize disc refiners in place of less efficient Jordans or conical refiners.

3. Optimize pressure drop across stock cleaner.

4. Optimize paper press section efficiencies by use of a grooved or blind drilled press roll in lieu of a vacuum roll.

The following measures were analyzed for technical feasibility since their implementation requires insubstantial capital, and they are, therefore, maintenance items:

1. Reduce excess air in steam boilers as well as in black liquor recovery boilers and wood waste burning boilers.

2. Optimize refiner plate design.

3. Recover stock from stock chest overflows.

4. Upgrade paper machine wet felts maintenance and replacement.

5. Improve maintenance and care of steam supply and dryer drainage system.

6. Recover and reuse water from vacuum pump seals, dry drainage heat exchanger cooling water, break and drive and bearing cooling water, "sweat dryer" cooling water.

7. Improve control of paper machine building ventilating air system to make maximum use of ambient conditions and building insulation.

B. *Efforts to reduce consumption of petroleum products and natural gas.* Fuel oil represents the largest single source of purchased fuels and its share is increasing as shown in Table 1. Natural gas is an important fuel source, but its role is declining at a rapid rate because the industry has apparently made an effort to convert from natural gas to fuel oil. Coal accounts for approximately 10 percent of purchased fuel. From 1972 to 1975 the paper industry increased its use of self-generated fuels including waste products from 41.7 percent to 43.4 percent of total energy consumption.

A clearer picture of energy source trends in the industry can be seen by reviewing the changes between the first quarters of each of the years, 1972, 1975, and 1976. Output by the paper industry began to increase in the latter part of 1975. In the first quarter of 1972, coal accounted for 11.4 percent of the energy consumed; by 1975 it had dropped to only 9.7 percent, but for 1976 its share increased slightly to 9.9 percent. These figures offer an indication that the drastic downward trend away from coal may have flattened out, and the percentage of coal usage may have stabilized. The trend for natural gas is clear. Gas will play a decreasing role in the paper industry. In the first quarter of 1972, 1975, and 1976 respectively, the percent of total enregy consumption was 19.5 percent, 15.7 percent, and 13.8 percent.

Over this same period, oil's share of energy consumption rose from 24.3 percent to 26.6 percent. By 1980, self-generated fuels will account for 47.3 percent of energy consumption while oil will account for 27.3 percent; natural gas, 10.3 percent; coal, 9.1 percent, and purchased electricity, 5 percent.

Both purchased electricity and natural gas were projected on the basis of their most recent trends. For natural gas the projected decline in consumption may even be too conservative. Purchased electricity is expected to continue its upward trend at a 59.3 percent rate of increase over the eight year period to 137 trillion Btu's in 1980.

V. PROPOSED TARGET DEFINITION

The proposed target was developed for SIC 26, on two separate bases, (1) in terms of fossil fuels and purchased energy and (2) in terms of total energy consumption including additional energy provided by burning self-generated waste materials. These targets are expressed in terms of percentage reduction in energy consumed per unit of production between the base year 1972 and January 1, 1980. The unit of production for the primary sector is tons of paper produced and for the secondary sector is million dollars of shipments. FEA determined from published reports what improvement in efficiency had been achieved by the industry from 1972 to the first quarter of 1976 and then developed anticipated improvements from that time forward. The first quarter of 1972 was selected to compare with the first quarter of 1976 to eliminate the possible effect of seasonal variations.

A. *Component goals.* Insufficient valid energy data were available to develop goals on a four-digit industry component basis. The secondary sector companies do not participate in the ongoing voluntary energy efficiency reporting program conducted by FEA/DOC in a joint undertaking. At least one existing third party trade association has extended an invitation to secondary sector companies to participate in their program which covers over 80 percent of the capacity of the primary sector. The component goals for the primary and secondary sectors are shown in Table 3.

B. *Proposed two-digit gross target.* A detailed study was undertaken in 32 paper mills in the primary sector which were representative of the industry. These studies provided data on the extent to which each potential conservation measure was being used or planned to be installed prior to January 1, 1980. The target support documents should be referred to in order to ascertain the impact that the selected conservation measures has on the draft target.

Table 3 below illustrates the derivation of the two-digit targets.

TABLE 3.—*The two-digit targets are derived as follows: SIC–26, January 1, 1980 target*

Sector I	Fossile fuel and purchased energy: 10⁶ Btu/ton	Percent savings	Total energy (10⁶ Btu/ton)	Basis percent savings
Consumption:				
First quarter 1972	38.2	(1)	34.0	(1)
First quarter 1976	18.2	(1)	22.6	(1)
Energy reduction by first quarter 1976:				
From waste materials	0.5	2.5	−0.2	−0.6
From all other effects	1.4	6.9	1.4	4.1
Subtotal	1.9	9.4	1.2	3.5
Estimated reduction, April 1, 1976 to January 1, 1980:				
New facilities	1.3	7.1	1.3	4.0
Capital projects	1.3	7.1	1.3	4.0
Alternate operating procedures	1.0	5.5	1.0	3.0
Increased waste material use	0.8	4.4	−0.2	−0.7
Subtotal	4.2	[2]24.1	3.4	[2]10.3
Total sector I target		[2]23.4		[2]12.8
Total sector II target		[2]12.0		[2]12.0
SIC–26 gross target		[2]31.4		[2]13.6
Weighted average	Use	[2]21.0	Use	[2]14.0

[1] Not available.
[2] Percent.

C. *Special circumstances effect.* Special circumstances are made up of non-discretionary demands on energy consumption often represented by government mandates on oil and water pollution abatement. Pollution abatement in the pulp and paper industry calls for highly efficient methods to respond to the current and future environmental discharge requirements. Many studies are available for data on energy needs to meet pollution abatement requirements in effect up to the target date of January 1, 1980, and the following projections of energy consumption for special circumstances have been made from these studies:

	Million Btu's per ton	
	Air	Water
To meet:		
1977 requirements	0.3	0.2.
X zero discharge		10.0 to 20.0.

NOTE.—X=Assuming a 26 pct. and a 63 pct. reduction in O/A water use.

The impact on the SIC–26 targets are judged to be as follows:

Percent of	Fossil fuel and purchased energy	Total energy basis
Pollution control offset	3.3	1.8
Use	3.0	2.0

Consideration of individual paper plant capacity utilization variances as an offset is a very cumbersome operation due to the inability to establish an acceptable energy value for the entire industry for variations in industry wide capacity utilization. This item will not be of any significance until January 1, 1980, and indeed it is moot if the utilization rate in the target year is equivalent to that in the base year.

D. *Proposed two-digit net target.* The net targets are developed by deducting the offsets from the gross target values which were developed earlier. Then the proposed net targets become:

Percent of	Fossil fuel and purchased energy	Total energy basis
Gross draft target	31.0	14.0
Offsets	−3.0	−2.0
Net draft targets	28.0	12.0

The target value published by FEA for the SIC 26 industry in the FEDERAL REGISTER on November 2, 1976, was the net target developed on the total energy basis.

VI. FINAL TARGET DEFINITION

A. *Comments and impact on the proposed target.* Testimony presented at the public hearing on December 9, 1976, and written comments were reviewed closely and are grouped into subject categories for more efficient response.

Several statements opposed setting the SIC 26 target on the basis of total energy consumption. Some comments suggested that the target should be based only on oil and gas consumption. FEA believes that the adoption of this recommendation would result in a target which would be based on too narrow a view of the energy consumption in the industry. Most statements recommended that the target be set on the basis of fossil fuels and purchased energy.

It should be noted that the paper industry's generation and use of waste fuel is directly related to the establishment of a meaningful target in three ways: (1) Waste materials have lower combustion efficiencies, which adversely affect overall energy efficiency by increasing total consumption; (2) substantial investment would be necessary to adequately monitor Btu, heat and moisture content of waste fuel and in the absence of such equipment it would be impractical to repeatedly estimate waste energy consumption, and (3) increased use of waste materials as fuel will directly reduce requirements for consumption of scarce energy resources, particularly oil and gas. Under the voluntary program of FEA and the Department of Commerce, target setting and reports on program progress are accomplished in terms of fossil fuels and purchased energy.

The primary waste materials of a paper mill (spent liquor, bark, and hogged fuel) may contain one or more fuel materials and therefore may have an impact on the fuel consumption of the industry. The increased use of waste as fuel will have a negative effect on energy efficiency because waste fuels have lower combustion efficiencies than fossil fuels. Because of the variety of waste material and the variability of moisture content, continual testing must be made to properly evaluate Btu value of energy from waste materials. The paper industry currently does not routinely measure Btu, heat content, and moisture content of its waste fuels, and equipment to do so is not generally installed. It would require substantial time, manpower and funds for the industry to install such equipment. It would, of course, be impossible to reestimate 1972 energy consumption using direct measurement, and comparisons with energy consumption of fuel from waste materials for subsequent years would be difficult. If only fossil fuel and purchased energy consumption are used, the data is the same for 1972 and all successive years. While consumption of energy from waste material requires increased consumption of such fuel because of its low combustion efficiency, it also results in decreased consumption of fossil fuel and purchased energy.

After reviewing the comments and support documents, FEA concluded that setting the energy improvement efficiency target on the basis of fossil fuels and purchased energy would provide the most direct contribution to conservation of scarce energy resources, and would provide the only practical basis for evaluating industry reports on energy consumption and efficiency improvement. Accordingly, the final published value establishes a target for energy efficiency improvement solely on the basis of fossil fuels and purchased energy.

Several statements cited recent capacity projections which indicate substantially lower 1980 capacity levels which would adversely affect the energy efficiency improvement potential from new facilities. The effect of the retirement of existing facilities and the installation of new, more energy efficient facilities between 1976 and 1980 was included in the evaluation of potential energy conservation for SIC 26. An average efficiency change for January 1, 1980, was projected based on estimated expansion and replacement of facilities and a 15 percent energy efficiency differential between new and old facilities. FEA has revised projected 1980 papr and paperboard capacity from 78.3 million tons to 74.0 million tons on the basis of the submitted data. FEA concludes that these revisions are reasonable in light of the estimated $4 billion capital shortfall estimated for the 1976 to 1980 period, and the industry's adjustments to eliminate this shortfall. In addition, these revisions eliminate all capacity which might be installed during 1980 and, therefore, represent the capacity available as of January 1, 1980. Energy efficiency improvements to be achieved through replacements and expansions of capacity are, accordingly, reduced from 7.1 percent to 4.3 percent.

Some comments also suggested that the 15 percent energy efficiency differential established by FEA was excessive because of the need to phase in new and replacement equipment and facilities. FEA wishes to point out that at any point in time, including 1972 and 1980, some new facilities are in the break-in phase, and that the efficiency differential

used compares reasonably to an average 20 percent differential between U.S. and Scandanavian mills and the 10 to 15 percent estimated by an EPA study for new plants.

In other comments, the assumed capacity utilization rate of 95 percent was considered to be unrealistic when compared with past history. Reduced capacity expansion will, however, require high operating rates if projected demand is to be met and the 95 percent rate approximates the 1972 rate. Accordingly, the 95 percent operating rate was retained. Provisions will be made to recognize lower operating rates in the future because of the significant impact.

Several comments pointed out that efficiency losses due to aging of facilities should be considered in determining the 1980 target. FEA has concluded that expenditures for annual maintenance of facilities are sufficient to retain efficiency of operation.

Several statements raised the issue that the energy efficiency target failed to consider capital and manpower shortages which would impose constraints on achievement of technologically feasible energy efficiency measures. The proposed target was developed on the assumption that the capital would be raised to implement energy efficient technologies or non-discretionary requirements such as pollution control and capacity expansion needed to meet demand. No capital is estimated to be available for retrofitting energy conservation measures. In spite of the existence of capital constraints on the paper industry, some energy projects will be carried out. This is because: (a) some opportunities have sufficiently attractive returns on investment to be substituted for production oriented investments, and (b) some projects may be carried out which offer lower than normally acceptable returns, but will be required due to present or projected scarcity of fuels and energy. In consideration of the shortage of capital, the efficiency gain to be obtained from energy efficient technologies, is estimated at 2.6 percent rather than the full 7 percent which is technologically feasible. With regard to comments on manpower shortages FEA concludes that such shortages could not occur if little or no capital investments are made. Accordingly FEA concludes that no adjustment of the target will be made for manpower constraints.

Several statements noted that additional operating procedures and equipment changes will be required in advance of meeting the 1983 pollution control standards. FEA concludes that these steps will not be instituted in sufficient number before 1980 to have a significant impeact on achivement of the 1980 target.

Some comments contended that the estimates of the difference in efficiency between waste and fossil fuels were not large enough. Average efficiencies based on actual experience and expert opinion were used to compute the negative effect of burning increased amounts of waste fuels, and FEA concludes that no modification of the efficiency differential is justified.

Some statements contended that the 1980 waste fuel consumption estimate was unrealistically high. After reviewing the data, FEA has revised the estimate of waste fuel consumption for 1980, and the offset for increased use of waste fuels have been adjusted downward fro 0.2 million Btu's per ton to 0.14 million Btu's per ton.

B. *Final Target.* The following table indicates the changes made in the proposed target value and the effect of special circumstances, and is based on fossil fuels and purchased energy only:

SIC–26 paper and allied products: Gross and net energy efficiency improvement targets for January 1, 1980

	Fossil fuels and purchased energy basis		
	10⁶ Btu's/ton	Percent savings	Integers to use
Primary sector:			
1972 energy consumption	19.0	(1)	
Energy reduction achieved, first quarter 1972 to first quarter 1976	1.80	[2] 9.5	
Target activity, second Quarter 1976 to January 1, 1980:			
Reductions due to new facilities	.78	4.3	
Reductions due to capital projects	.49	2.6	
Reduction due to alternate operating procedures	.98	5.2	
Reductions due to increased burning of waste materials	.36	1.9	
Subtotal	2.65	[2] 14.0	
Primary sector subtotal	4.45		
Primary sector gross goal		23.5	
Secondary sector gross goal		12.0	
SIC–26 Gross target		[2] 22.5	[2] 23.0
Offsets:			
Loss in energy savings per ton for pollution control	−.60		
Resulting reduction in projected efficiency		[2] −3.3	[2] −3.0
Final net savings per ton of pulp/paper	3.85		
Final net target			[2] 20.0

(1) Not available.
(2) Percent.

A summary of the development of the SIC 26 paper and allied products industry is as follows:

	Percent
Gross Target (based on maximum energy efficiency achievable without consideration of special circumstances of conditions of the industry)	23
Offset (required for special industry circumstances and conditions)	3
Net target (based on maximum efficiency achievable with consideration of special circumstances and conditions)	20

APPENDIX D: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 28—CHEMICALS AND ALLIED PRODUCTS

I. *Industry description and energy base.* The chemicals and allied products industry, comprising Standard Industrial Classification SIC 28, consists of 28 four-digit product classifications. This major group produces basic chemicals and manufactured products using predominantly chemical processes. Companies classified in this major group produce three general classes of products: (1) Basic chemicals such as acids, alkalies, salts and organic chemicals; (2) chemical products to be used in further manufacture, such as synthetic fibers, plastics materials, dry colors, and pigments; (3) finished chemicals products to be used for ultimate consumption such as drugs, cosmetics, and soaps; or to be used as raw materials in other industries such as paints, fertilizers, and explosives. Companies that are primarily engaged in packaging, repackaging or bottling of purchased chemical products, instead of producing products, are not included in this industry group. The table below sets forth the energy consumption of the four-digit classifications of SIC 28 for the base year 1972.

SIC	Product	1972 energy consumed 10^12 Btu	Subtotals	Percent of total energy consumed
	Industrial inorganics		868.42	27.1
2812	Alkalies and chlorine	301.47		
2813	Industrial gases	72.03		
2816	Inorganic pigments	65.01		
2819	Industrial inorganic chemicals	494.13		
	Plastics and synthetics		465.70	15.3
2821	Plastics materials and resins	198.13		
2822	Synthetic rubber	93.24		
2823	Cellulosic man-made fiber	77.66		
2824	Organic fibers, noncellulosic	164.68		
	Drugs		69.21	2.1
2831	Biological products	2.87		
2833	Medicinals and botanicals	23.87		
2834	Pharmaceutical preparations	42.47		
	Soaps, cleaners, toilet goods		61.00	2.0
2841	Soap and detergents	32.36		
2842	Polishes and sanitation goods	7.37		
2843	Surface active agents	13.22		
2844	Toilet preparations	8.46		
	Paints		19.52	.6
2851	Paints and allied products	19.52		
	Industrial organic chemicals		1,270.70	41.5
2861	Gum and wood chemicals	11.27		
2865	Cyclic crudes and intermediates	146.36		
2869	Industrial organic chemicals	1,122.10		
	Agricultural chemicals		231.05	7.5
2873	Nitrogenous fertilizers	137.76		
2874	Phosphatic fertilizers	70.14		
2875	Fertilizers, mixing only	7.50		
2879	Agricultural chemicals	15.75		
	Miscellaneous chemical products		119.63	3.9
2891	Adhesives and sealants	20.95		
2892	Explosives	20.53		
2893	Printing ink	5.50		
2895	Carbon black	22.48		
2899	Chemical preparations	44.37		
	Total	3,067.37		100.0

The two "catch-all" categories of SIC 2819, Industrial Inorganic Chemicals and SIC 2869, Industrial Organic Chemicals consume over one-half of the total energy consumed by SIC 28. These two groups together with SIC 2812, Alkalies and Chlorine; SIC 2822, Synthetic Rubber; SIC 2873, Nitrogeneous Fertilizers; SIC 2823, Cellulosic Man-made Fibers (rayons); SIC 2824, Organic Fibers, Noncellulosic (nylon, polyester, acrylic); SIC 2821, Plastics Materials and Resins; SIC 2865, Cyclic Crudes and Intermediates, Dyes, Organic Pigments, account for over 80 percent of the total energy consumed by SIC 28. These nine four-digit components were selected for analysis in depth due to their substantial impact on the aggregated two-digit industry target.

In order to demonstrate fully the extremely heterogeneous nature of this industry and to illustrate the products that consumed the quantities of energy revealed above, the following paragraphs indicate the major products or product classes that are included in each four-digit classification.

SIC 2812, Alkalis and Chlorine, includes chlorine, synthetic sodium carbonate (soda ash), sodium hydroxide (Caustic Soda), potassium hydroxide (caustic potash), and other alkal.

SIC 2813, Industrial Gases, including acetylene, carbon dioxide, argon, helium, hydrogen, nitrogen, oxygen, nitrous oxide, and other industrial gases.

SIC 2816, Inorganic Pigments, includes titanium pigments, white lead, zinc oxide pigments, all other white opaque pigments, chrome colors (five specified plus "other"), white extender pigments, iron oxide pigments, colored lead pigments, iron blues, pearl essence, carbon blacks (bone and lamp only), ceramic colors, and all other color pigments.

SIC 2819, Industrial Inorganic Chemicals, N.E.C., includes inorganic acids except nitric and phosphoric, aluminum oxide, other aluminum compounds, potassium and sodium compounds, chemical catalytic preparations, reagent and high-purity grades of inorganic chemicals, bromine, calcium hypochlorite, activated carbon, hydrogen peroxide, iodine, mercury, phosphorus, sulfur, radioactive isotopes and radiation sources from non-AEC plants, and 32 specific classes of other inorganic chemicals plus "all other".

SIC 2821, Plastics Materials and Resins, includes more than 40 specific categories of high polymers, with hundreds of formula and process variations. The major plastics and resins materials include polyethylene (high-, medium-, and low-density), polypropylene, ABS (acrylonitrile-butadienestyrene), PVC (polyvinyl chloride), polystyrene, and phenolics.

SIC 2822, Synthetic Rubber, includes SBR (styrene-butadiene rubber), polybutadiene, butyl, polyisoprene, EPT (ethylene-propylene terpolymer), nitrile (butadiene-acrylonitrile rubber), neoprene, chlorosulfonated polyethylene, polyisobutylene, and acrylic, fluoro, polysulfide, and silicone elastomers. Polyurethane rubbers are not included.

SIC 2823, Cellulosic Man-made Fiber, includes yarn, staple, and tow products of acetate, viscose rayon, and cuprammonium rayon.

SIC 2824, Organic Fibers, Noncellulosic, includes filament yarn, textile monofilaments, staple, and tow made of nylon (polyamide), acrylic and modacrylic, polyester, polyolefin, saran, spandex, anidex, vinyon, fluorocarbon, and others. Glass fibers are excluded.

SIC 2831, Biological Products, includes blood and blood derivatives, vaccines, antigens, antitoxins, toxoids, toxins, diagnostic substances, and other biologics for human use and vaccines, viruses, bacterins, serums, antitoxins, toxoids, diagnostics, and other biologics for veterinary use.

SIC 2833, Medicinals and Botanicals includes antibiotics, botanical drugs, naturally occurring vitamins, drugs of animal origin and many other organic and inorganic drugs sold in bulk to other establishments.

SIC 2834, Pharmaceutical Preparations, includes both ethical (prescription) and proprietary (over-the-counter) pharmaceutical preparations that are ready for human or veterinary use. Included are many types of preparations each designed to act on one of nine broad categories of human ailments or for veterinary use. A few examples of the types of preparations are hormones, analgesics, antipyretics, anticonvulsants, tranquilizers, amphetamines, and barbiturates.

SIC 2841, Soap and Other Detergents, includes the broad categories of alkaline detergents, soaps, synthetic organic detergents, heavy-duty phosphate-based detergents, heavy-duty phosphate-free detergents, light-duty detergents, and presoaks. They may be in chip, flake, granulated, powdered, spray-dried, liquid, paste, or bar form, and are classified separately for household and non-household use.

SIC 2842, Polishes and Sanitation Goods, includes household bleaches; specialty cleaners for windows, ovens, toilet bowls, wallpaper and walls, rugs and upholstery; disinfectants, household ammonia; nonpersonal deodorants; dry cleaning preparations; household laundry and ironing aids; polishes for automobiles, furniture, floors, shoes, and leather; and other polishes and sanitation goods.

SIC 2843, Surface Active Agents, includes assistants and finishes for textiles and leather and bulk production of amphoteric, anionic, cationic, and nonionic surface active agents used chiefly as detergents, dispersing agents, emulsifiers, foaming agents, or wetting agents.

SIC 2844, Toilet Preparations, includes shaving preparations, perfumes, toilet water, colognes, hair preparations (including shampoos), dentifrices, creams, lotions, oils, lipstick, rouge, eye preparations, personal deodorants, manicuring preparations, powder, bath salts, and other cosmetics and toiletries.

SIC 2851, Paints and Allied Products, includes many trade-sale products marketed as exterior oil-type and water-type paints, interior oil-type and water-type paints, and lacquers, industrial lacquers and other paints, putty, and miscellaneous paint products. Most of these products are specially formulated for specific applications.

SIC 2861, Gum and Wood Chemicals, includes gum and wood turpentine and rosin, pine oil, charcoal, natural acetic acid and methanol, natural tanning and dyeing materials and chrome tanning mixture, tall oil, and other gum and wood chemicals.

SIC 2865, Cyclic Crudes and Intermediates, includes benzene, toluene, and xylene derived from coal-tar distillation, naphthalene, anthracene, pyridine, carbazole, derivatives of these chemicals, other cyclic intermediates, synthetic organic dyes, synthetic organic pigments, and cyclic (coal-tar) crude products such as light oils, coal-tar acids, creosote oil, and tar.

SIC 2869, Industrial Organic Chemicals, N.E.C., includes a diversity of products such as acetic, chloroacetic, adipic, formic, oxalic, tartaric, and other organic acids and their

metal salts; chloral, formaldehyde, methylamine; such chlorinated solvents as carbon tetrachloride, perchloroethylene and trichloroethylene; many polyhydric alcohols; many synthetic perfume and flavoring materials, including saccharine and vanillin; cyclic and acyclic rubber processing chemicals, many plasticizers, synthetic tanning agents; and many other organic chemicals.

SIC 2873, Nitrogenous Fertilizers, includes anhydrous ammonia, nitric acid, ammonium nitrate, ammonium sulfate, ammonium chloride, urea, nitrogen solutions, and fertilizer materials of organic origin.

SIC 2874, Phosphatic Fertilizers, includes phosphoric acid (from phosphorus and from phosphate rock), normal, enriched, and concentrated superphosphates, ammonium phosphates, nitrophosphates, calcium metaphosphates, defluorinated superphosphate and phosphate rock (feed grade), and other phosphatic fertilizer materials.

SIC 2875, Fertilizers, Mixing Only, includes fertilizers mixed from purchased fertilizer materials. Complete and incomplete mixtures are both shipped in both dry and liquid forms.

SIC 2879, Agricultural Chemicals, N.E.C., includes agricultural insecticidal preparations, such as those containing arsenic compounds, benzene hexachloride, DDT, chlorinated hydrocarbon pesticides, organic phosphates, botanical products, and other insecticidal materials; agricultural herbicidal preparations containing such materials as sodium arsenite, sodium chlorate, 2, 4–D, 5–T, defoliants, desiccants, plant-growth regulators, carbamates, and other herbicides; agricultural fungicides; soil fumigants; and household and industrial insecticides, repellants, attractants, rodenticides, fumigants, and others.

SIC 2891, Adhesives and Sealants, includes animal glues, protein adhesives, vegetable adhesives, asphaltic and coal-tar adhesives, and other natural adhesives based on gums, shellac, silicates, lacquers, and oleoresin. Synthetic adhesives include epoxies, phenolics, ureas, vinyls, cellulosics, acrylics, polyesters, polyamides, and others. Also included are hot-melt adhesives, adhesive films, rubber cement, and sealants and caulking compounds based on many natural and synthetic polymers.

SIC 2892, Explosives, includes such explosives as amatol, azides, nitrates carbohydrates, cordite, mercury fulminate, nitroglycerin, pentolites, picric acid, RDX, tetryl, and TNT and DNT. Such auxiliaries as blasting caps, fuse powder, fuses, and well-shooting torpedoes are included. Products of government owned, contractor-operated plants are not included.

SIC 2893, Printing Ink, includes letterpress, lithographic, and offset inks in black and color for news, publication, packaging, and other purposes; gravure inks for packaging, publication and other gravure inks for packaging, publication, and other gravure uses; flexographic inks for packaging (paper, board, film, and foil) and other flexographic uses; and special inks for textile, screen stencil, and other printing.

SIC 2895, Carbon Black, includes carbon black made by the furnace and channel processes.

SIC 2899, Chemical preparations, N.E.C., includes evaporated salt, saturated and unsaturated fatty acids, tall oil, fatty acids, gelatin (except ready-to-eat desserts), essential oils, fireworks and pyrotechnics, automotive chemicals, concrete curing agents, drilling mud materials, foundry chemicals, household tints and dyes, insulation products, metal-treating compounds, oil-treating compounds, rosin and other sizes, writing and stamp pad inks, water-treating compounds, water-proofing compounds, embalming chemicals, vitreous enamel, plating compounds, lighter fluids, waxes (except pure petroleum waxes), and other industrial chemical specialties.

Energy sources for the base year 1973 for SIC 28, chemicals and allied products, were as follows:

Fuel	Btu×10¹² quantity	Percent
Coal	526.6	17.1
Coke	5.0	.2
Distillate fuel oil	93.8	3.0
Residual fuel oil	131.8	4.3
Natural gas	1,648.0	53.3
Other fuels	293.2	9.5
Purchased electricity	377.3	12.2
Self generated electricity	11.7	.4
Total energy consumed (all fuels)	3,087.3	100.0

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

The data on potential conservation measusers were developed from several major sources, such as: (1) Technical literature on advancing technology, (2) calculations of energy consumption in new processes, (3) discussions with knowledgeable specialists in the chemicals industry, and (4) discussions with engineering construction firms specializing in new plant construction. These sources also provided estimates of increases in energy consumption that would result from environmental control systems, occupational health and and safety control systems, shifts in product mix, changes in available raw materials, and other special circumstances.

Practices for making technical and economic evaluations differ from one four-digit classification to another and from one company to another within a classification. Expert judgment was required to assess actual industry practice to determine the proper impact of each conservation option on the resulting component goal.

The energy conservation options that were considered may be broadly classified as follows:

1. Housekeeping and maintenance.
2. Process control and energy balancing.
3. Equipment modification or replacement in present processes.
4. Building of new plants with present or new technology.

A. *Technological feasibility.* The following criteria were used for screening all four-digit classifications for acceptability of potential conservation measures. These criteria were augmented by specific considerations applicable to the nine four-digit classifications which were studied in depth.

1. Can the technology be implemented by January 1, 1980?
2. Had the technology been demonstrated suitably?
3. Can the technology be applied as retrofit?
4. Can retrofit be accomplished without excessive shut-down?
5. Is the technology size limiting?
6. Is the measure consistent with the necessity to reduce use of natural gas?
7. Is the technology consistent with existing plans of industry?

B. *Economic practicability.* The economic screening operation was based on the following criteria:

1. Estimated return on investment: (a) For energy conserving equipment and plant modification; (b) for competing investment opportunities in non-energy conserving items.
2. Markets and marketing: (a) Company position; (b) growth of market.
3. Age of plant and process.
4. Technical obsolescence.
5. Operating rate.
6. Situational criteria: (a) Downtime involved during construction; (b) space required for proposed equipment; (c) manpower available for engineering and construction.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

A. *Required return on investments.* Since all conservation investments for the purpose of achieving targets by January 1, 1980, are short-term investments, they must compete with existing short-term competing investment opportunities that are currently returning at least 15 percent after taxes in the heavy chemicals, plastics, and ammonia industries.

The heterogeneous nature of the chemicals industry requires a company by company analysis to determine the hurdle rates that technologically feasible conservation measures must exceed on calculated rates of return on investment to be able to compete with other investment opportunities. Due to the increasing costs of energy, most energy related investment opportunities have lower risks attached to them and can generally compete with higher risk investment opportunities.

B. *Capital spending priorities.* Almost all large companies have well defined criteria to guide investment decisions. They range from simple payout estimates to sophisticated discounted cash flow analysis depending upon the amount, duration, and either specified or implied risks of making a profit from the expenditure.

After allocation of available capital to mandatory investments such as air and water pollution control, plant maintenance, conversion to fuels other than natural gas, strategic investments, and occupational safety and health requirements, each company has its own criteria for allocation of remaining funds, which may be due at least to some of the following differences among companies in SIC 28:

1. Differing patterns of product/process integration.
2. Differences in proprietary processes.
3. Differences in raw materials and processing for the same product.
4. Differing geographic locations relative to markets.
5. Differing fuels available and costs.
6. Differing state regulations on environment, energy, occupational health and safety.
7. Differing patterns of integration for energy conservation.

Because of these differences and the lack of firm data on the decision process, the chemical and allied products industry does not lend itself to any easy economic analysis of how energy prices and applicable hurdle rates effect estimated goals at the four-digit level.

Most companies permit energy related projects to use reasonable forecasts of future energy prices. Project life, however, is either explicitly or intuitively kept relatively short to reduce risk. This short life, or course, is normal practice for improvements to old plants, but seems inappropriate for application to newer plants. On the other hand many companies permit slightly longer payout periods, or lower return on investment than normal for low investment energy-related projects. However, large investments must meet the same criteria as any other corporate investment.

All companies face the high costs of borrowed funds, the uncertainties of energy price forecasts, and the uncertainty of public policy and federal and local regulations as they apply to the duration of benefits to be obtained by energy conservation program. Each company's economic evaluation takes these into account, but in general large

chemical companies assume a 5 or in some cases a 10 year project life for other than new plants.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

A. *Potential measures identified.* The target support documents which are available for examination at the locations and times specified in the body of this notice contain details of the consideration of potential energy conservation measures. This appendix will discuss only the major aspects of the assessment.

All four-digit classifications were evaluated for application of energy conservation activities in the following categories:

1. Reducing excess air in firing steam boilers and process heaters.
2. Increasing maintenance (traps and tanks) and insulation on steam systems.
3. Increasing recovery of waste heat from process steam and stack gases.
4. Recovering wastes for fuel values.
5. Optimizing process controls with respect to energy saving at higher energy costs.

In addition the nine four-digit classifications that consume over 80 percent of the energy used in the chemical and allied products industry were analyzed in greater depth.

Major potential conservation opportunities were identified in the following nine components. A capsulized form of the findings is included but a more informative treatment is contained in the target support documents.

1. *SIC 2812, alkalies and chlorine.* Energy savings can be achieved in new plants, and in the use of metal anodes, hydrogen recovery, modified diaphragms, expandable electrodes, changes in cell geometry, additional stages in caustic evaporators, and combined steam-electric generators. Most plants now operating on natural gas have installed standby facilities for use of liquid fuels. Since most plants are on the Gulf Coasts, the shortage and high cost of coal preclude its use.

2. *SIC 2819, industrial inorganic chemicals.* The heterogeneous mix of chemicals in this group is produced by simple and unsophisticated processes. The newest technology is likely to be employed only in new plant construction. Improved housekeeping and increased use of waste energy emerge as the most feasible conservation measures.

3. *SIC 2821, plastic materials, synthetic resins, and non-vulcanizable elastomers.* Converting from solution processes to bulk polymerization, increasing the conversion of monomer to polymer; and replacing slurry or solution processes for manufacture of high-density polyethylene with newer gas-phase polymerization are the major measures for conservation. Housekeeping improvements, systems optimization, increased insulation of piping and buildings, reuse of hot water, improved solvent recovery, revised drying methods can also result in energy savings.

4. *SIC 2822, synthetic rubber (vulcanizable elastomers).* Using emulsion processes instead of current solution processes for production of SBR (styrene-butadiene rubber) which accounts for about 62 percent of the volume of products in this component is a major conservation measure. Additional savings are achievable through the use of special catalysts and new solvents.

5. *SIC 2823, cellulosic man-made fibers.* Conservation measures include improved housekeeping, better planning and scheduling. Since a significant decrease in the output of this component is expected by 1980, no new plants are planned, nor is much development of new processes expected.

6. *SIC 2823, synthetic fibers, except cellulosic.* While existing plants can use improved housekeeping, better planning and scheduling, new plants can show savings in energy consumption of up to about 30 percent with better layout, better design more efficient process equipment, better waste heat recovery, pressure let-down turbines, and balancing of high and low pressure steam mains.

7. *SIC 2865, cyclic (coal tar) crudes, and cyclic intermediates, dyes, and organic pigments and toners.* Conservation measures include use of improved housekeeping, engineering improvements, and major process restructuring or introduction of new technology. Switching from natural gas to liquid or solid fuels represents an economic penalty, due to lower firing efficiency but does not significantly affect energy usage. Most firms are conditioned to and are preparing to switch to liquid fuels. No company interviewed is switching to solid fuel.

8. *SIC 2869, industrial organic chemicals, not elsewhere classified.* Conservation efforts should include housekeeping, upgraded efficiency of boiler houses and steam systems, better maintenance, and shutting down equipment instead of idling. Pressure let-down energy recovery measures, recovery and use of off-gasses containing usable energy content, improved heat recovery through heat exchangers, improved process control instrumentation, and improved solvent recovery systems were also identified as conservation measures.

9. *SIC 2873, nitrogenous fertilizers.* New ammonia plant designs which operate at a lower pressure, more efficient compressors, more complete recovery of waste heat and use of more efficient refrigeration circuit are major potential conservation measures. Older ammonia plants can recover heat from stack gases of the reformer furnaces, and also recover hydrogen from purge gas by cryogenic techniques. Since production of ammonia consumes 98 percent of the total energy in this component industry, conservation measures affecting ammonia plants are crucial.

B. *Industry efforts to reduce use of petroleum products and natural gas.* The chemical and allied products industry has recognized the need for substituting liquid fuels wherever possible for natural gas and in most companies this is under way. On the basis of cost there seems to be little advantage for using new intrastate gas instead of a liquid fuel, but certain advantages still make natural gas the more attractive fuel, mainly its clean burning characteristics. However, most companies in the chemical industry who were dependent on natural gas have installed or are installing facilities for alternative fuels, primarily liquid petroleum products. Even though a few companies have announced plans for converting to coal, few such conversions can be expected before January 1, 1980.

V. PROPOSED TARGET DEFINITION

A. *Component goals.* There was insufficient valid energy consumption data available on this industry to complete development of the effect of special circumstances prior to the publication of proposed targets on November 2, 1976. Work on this industry continued following the publication. As a result only the net target was available for publication and was announced on November 2, 1976, in the FEDERAL REGISTER. This was based on the following net component goals.

SIC–28, Chemicals and allied products; initial energy efficiency goals by industry classification

SIC	Industry	Net goals (percent)
2812	Alkalies and chlorine	8.8
2813	Industrial gases	8.1
2816	Inorganic pigments	8.4
2819	Industrial inorganic chemicals, n.e.c.	4.1
2821	Plastics, synthetic resins, etc.	17.9
2822	Synthetic rubber	24.8
2823	Cellulosic manmade fibers	10.8
2824	Synthetic organic fibers, ex cellulosic	22.7
2831	Biological products—NA	19.9
2833	Medicinal chemicals and botanicals—NA	
2834	Pharmaceutical preparations—NA	
2841	Soap, detergents, etc.	15.3
2842	Specialty, cleaning, polishing, sanitation	13.7
2843	Surface active agents, etc.	13.1
2844	Perfumes, cosmetics, etc.	14.5
2851	Paints, varnishes, lacquers, etc.	11.6
2861	Gum and wood chemicals	10.1
2865	Cyclic (coal tar) crudes, etc.	18.9
2869	Industrial organic chemicals, n.e.c.	17.0
2873	Nitrogeneous fertilizers	15.1
2874	Phosphatic fertilizers	28.2
2875	Fertilizers, mixing only	22.4
2879	Pesticides and agricultural chemicals, n.e.c.	15.2
2891	Adhesives and sealants	10.0
2892	Explosives	30.2
2893	Printing ink	9.5
2895	Carbon black	39.4
2899	Chemicals and chemical preparation, n.e.c.	18.6
	Proposed SIC–28 net target	16.0

B. *Proposed two-digit net target.* Energy usage in the target year included usage of energy to meet special circumstances when the target was originally published. The energy use was determined for the proposed net target by analyzing each four-digit classification against all energy conservation measures screened for technological feasibility and economic practicability. These component goals were then aggregated into the two-digit industry target using the component total energy consumptions as weighting factors. The production increase between 1972 and the target year was then utilized to calculate the resulting total energy use in 1980.

C. *Special circumstances effect.* Since the impact of special circumstances was not separately identified in setting the proposed target, only the net target was published.

VI. FINAL TARGET DEFINITION

A. *Comments and impact on proposed target.* Testimony given at the public hearing, held on December 7, 1976, in Washington, D.C., and written comments raised several issues which have been considered before final target for SIC 28 were established.

Some comments expressed concern about the reliability of estimates underlying the base year 1972, the improvement estimated, for January 1, 1980, and the percentage goals derived for specific component industries. FEA has carefully reviewed the data available to it in the light of these concerns and concludes that no new data were offered which would change the SIC–28 industry target as proposed.

Nearly all commenters noted that if changes in the underlying data occur before January 1, 1980, the target for the industry should be modified. While there is no disputing this concern, it should be noted that Section 374 of the EPCA provides a mechanism for the subsequent modification of establishing targets.

Some comments noted either directly or by implication that both available capital

and available manpower could limit progress in energy conservation. While FEA recognizes the relevance of such limiting factors, it believes that a realistic assessment of what could be achieved by industrial establishments has been made. In particular FEA recognizes that the priority position of energy-conservation investments relative to other uses of capital may differ from company to company as well as over time with an individual company.

Industrial commenters seem uniformly concerned that the component goals which were aggregated as an industry-wide target would be applied indiscriminately to their own industries or companies. The FEA is only charged with setting a voluntary target for an SIC code industry. The component goals are not directly applicable to either component industries or individual companies.

B. *Final targets.* After the proposed net target was published for comment, FEA initiated a further review of the underlying data with particular regard to the impact of special circumstances. As a result of this review the initial estimates of energy usage for the nine major four-digit classifications were modified and the estimated energy consumption required to meet special circumstances was determined. Special circumstances applicable to SIC 28 were found to include the following:

1. Energy consumption required by measures to comply with mandated environmental and occupational safety and health regulations.

2. Energy consumption related to nondiscretionary changes in the quality of raw materials.

3. Energy consumption related to changes in product mix caused by outside sources.

The following table illustrates the data on 1980 energy usage and the allocation of energy for special circumstances for the four-digit classifications.

Final estimates of energy consumption by industry component

Class	Name	1980 energy usage		Energy required by special circumstances (10^{12} Btu's)
		With 1972 technology (10^{12} Btu's)	With 1980 technology gross (10^{12} Btu's)	
2812	Alkalies and chlorine	364.0	[illegible]	7
2813	Industrial gases	111.0	102.0	<1
2814	Inorganic pigments	98.0	90.0	8
2819	Industrial inorganic chemicals, n.e.c	[illegible]	549.0	20
2821	Plastics, synthetic resins, etc	255.0	280.0	2
2822	Synthetic rubber	75.5	82.5	3
2823	Cellulosic manmade fibers	[illegible]	50.7	1
2824	Synthetic organic fibers, ex cellulosic	[illegible]	216.0	5
283	Pharmaceuticals	147.0	111.0	7
2841	Soap, detergents, etc	49.7	49.2	2
2842	Specialty, cleaning, polishing, sanitation	14.3	11.9	<1
2843	Surface active agents, etc	17.0	14.5	<1
2844	Perfumes, cosmetics, etc	11.9	10.6	<1
2851	Paints, varnishes, lacquers, etc	[illegible]	25.7	1
2861	Gum and wood chemicals	9.6	8.5	<1
2865	Cyclic (coal tar) crudes, etc	[illegible]	[illegible]	5
2869	Industrial organic chemicals, n.e.c	1,674.0	1,383.0	24
2873	Nitrogeneous fertilizers	[illegible]	[illegible]	[illegible]
2874	Phosphatic fertilizers	167.0	[illegible]	9
2875	Fertilizers, mixing only	18.7	11.6	1
2879	Pesticides and agricultural chemical, n.e.c	52.4	40.7	4
2891	Adhesives and sealants	17.0	14.3	1
[illegible]	Explosives	[illegible]	45.8	2
[illegible]	Printing ink	3.3	2.8	<1
2895	Carbon black	[illegible]	37.0	2
2899	Chemicals and chemicals preparation, n.e.c	[illegible]	54.1	2
	Totals (rounded)	4,800.0	[illegible]	130

SIC–28, chemicals and allied products—initial and revised energy efficiency goals by industry and subclass

Class	SIC component name	Initial goal, G_N [1] (percent)	Revised goals (percent) [1]	
			G_N	G_G
2812	Alkalies and chlorine	[illegible]	[3] 8.4	[3] 11.1
2813	Industrial gases	8.1	8.2	8.9
2816	Inorganic pigments	8.4	[4] .1	[3] 8.3
2819	Industrial inorganic chemicals, not elsewhere classified	4.1	[3] 2.2	[3] 5.5
2821	Plastics, synthetic resins, etc	17.9	[3] 16.7	[3] 17.7
2822	Synthetic rubber	[illegible]	[3] 12.8	[3] 17.2
2823	Cellulosic man-made fibers	10.8	[3] 10.9	[3] 12.6
2824	Synthetic organic fibers, ex cellulosic	[illegible]	[3] 19.1	[3] 20.7
2831	Biological products	(5)		
2833	Medicinal chemicals and botanicals	(5)		
2834	Pharmaceutical preparations	(5)		
2841	Soap, detergents, etc	18.5	20.5	24.7
2842	Specialty, cleaning, polishing, sanitation	14.3	15.0	19.1
2843	Surface active agents, etc	12.7	14.0	16.8
2844	Perfumes, cosmetics, etc	[illegible]	13.0	14.7
2851	Paints, varnishes, lacquers, etc	14.3	15.0	10.9
2861	Gum and wood chemicals	11.0	10.8	13.2
2865	Cyclic (coal tar) crudes, etc	10.1	10.4	11.4
2869	Industrial organic chemicals, not elsewhere classified	16.0	[3] 18.4	[3] 20.1
2873	Nitrogeneous fertilizers	17.0	[3] 15.9	[3] 17.4
2874	Phosphatic fertilizers	15.1	15.0	20.2
2875	Fertilizers, mixing only	15.2	18.0	23.3
2879	Pesticides and agricultural chemicals, not elsewhere classified	[illegible]	21.3	20.1
2891	Adhesives and sealants	13.7	14.9	21.3
2892	Explosives	10.0	9.4	16.0
[illegible]	Printing ink	20.2	20.2	23.1
2895	Carbon black	[illegible]	9.1	15.2
2899	Chemicals and chemical preparation, not elsewhere classified	30.4	30.5	41.6
	Total 28	[illegible]	17.9	20.7
		[illegible]	14.1	16.8

[1] G_N=a net goal which includes energy required for environmental systems and changes in production mix; G_G=a gross goal with no consideration for offsetting circumstances.
[3] Estimates that were modified by additional estimates and data.
[4] Estimates that had been modified by additional dates and analyses.
[5] Not elsewhere classified.

	Annualized rate of energy usage by SIC 28 on Jan. 1, 1980 (in quads) 10^{15} Btu
With 1972 energy usage and management	4.80
With maximum feasible energy (gross) conservation (but not consideration of special circumstances)	3.99
For energy conservation (offset), including energy requirements for environmental systems, changes in product mix, etc	.13
With maximum feasible energy (net) conservation, including energy requirements for environmental systerms changes in product mix, etc	4.12

The following is the energy efficiency improvement target set by FEA for SIC 28:

	Percent
Gross target (based on maximum energy efficiency achievable without consideration of special circumstances or conditions of the industry)	17
Offset (required for special industry circumstances and conditions)	3
Net target (based on maximum energy efficiency achievable with consideration of special circumstances and conditions)	14

APPENDIX E: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 29—PETROLEUM AND COAL PRODUCTS

I. INDUSTRY DESCRIPTION AND ENERGY BASE

The petroleum and coal products industry is made up of companies engaged in refining petroleum, manufacturing paving and roofing materials, and compounding lubricating oils and greases from purchased materials. This industry is identified as Standard Industrial Classification (SIC) 29. The industry may be further divided into five four-digit SIC product classifications which are listed below with the figures on energy consumption by each classification for the 1972 base year:

SIC	Industry	1972 energy consumed 10^{12} Btu's	Percent of total
2911	Petroleum refinery	2,934.30	98.0
2951	Paving mix and blocks	25.97	.9
2952	Asphalt felts and coatings	19.25	.6
2992	Lubricating oils and greases	5.46	.2
2999	Products of petroleum and coal	7.50	.3
	Totals	2,992.52	100.0

The following paragraphs indicate the significant products that are included in each of the SIC categories.

SIC 2911, petroleum refining, comprises establishments primarily engaged in producing gasoline, kerosene, distillate fuel oils, residual fuel oils, lubricants, and other products from crude petroleum and its fractionation products by use of straight distillation of crude oil, redistillation of intermediate products so produced, plus further cracking of heavy molecules and by other processes.

SIC 2951, paving mixtures and blocks, comprises establishments primarily engaged in manufacturing asphalt and tar paving mixtures, and paving blocks made of asphalt, creosoted wood, and various compositions of asphalt or tar with other materials.

SIC 2952, asphalt felts and coatings, comprises industries engaged in manufacturing

asphalt and other saturated felts in roll or shingle form, either smooth or faced with grit, and in manufacturing roofing cements and coatings.

SIC 2992, lubricating oils and greases, comprises establishments engaged in blending, compounding, and rerefining lubricating oils and greases from purchased mineral, animal, and vegetable materials. This component ships about 20 percent of all lubricating oils and greases and the balance essentially is shipped by the SIC 2911 petroleum refining component.

SIC 2999, petroleum and coal products, not elsewhere classified, comprises establishments manufacturing fuel briquettes, boulets, packaged fuel, powdered fuel, and other similar products. The largest element is calcined petroleum coke used for producing industrial electrodes for steel and aluminum producers.

Because it accounts for 98 percent of energy consumption, the petroleum refining component (SIC 2911) is the primary focus for potential energy conservation within the petroleum and coal products industry. Energy sources for the petroleum refining component, SIC 2911 in 1972 were as follows:

Source	Quantity	Percent of total Btu's
Distillate fuel oil	[1] 12.25	0.90
Residual fuel oil	[1] 108.85	8.60
Liquefied petroleum gas	[1] 36.76	1.85
Natural gas	[2] 2,851.30	36.86
Refinery gas	[2] 2,886.30	35.84
Refinery coke	[3] 30,767	11.62
Coal	[3] 929	.28
Electricity	[4] 61.95	2.65
Purchased steam	[4] 92.79	1.40
Totals	[5] 2,934.3	100.00

[1] 1,000 bbl/d.
[2] 1,000,000 standard ft³/d.
[3] Short tons per day.
[4] 1,000,000 kWh/d.
[5] Times 10^{12} Btu's.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

A. *Technological feasibility.* Each potential conservation measure was first evaluated according to the following criteria to determine if it was technologically feasible:

1. Has the measure been demonstrated in newly designed plants?
2. Has the measure been demonstrated in retrofit installations?
3. Is the technology still in development with no prospect for use before January 1, 1050?
4. Are there any technical limitations related to size of plant?
5. Does industry accept the measure as fully demonstrated?
6. Does the potential measure satisfy environmental requirements?

Those potential measures which satisfied these initial criteria were then measured against the following time constraints:

1. What is the total lead time required for installation and operation?
2. What shut-down time is required in existing plants for retrofit installation or tie-in?
3. What resources in special materials and manpower are required?
4. Is the measure consistent with plans of the industry to conserve energy?
5. Is the measure consistent with the possibility of curtailment of natural gas?

B. *Economic practicability.* Each measure that satisfied the above criteria was then evaluated according to the following economic criteria:

(a) How much energy would be investment save?
(b) What is the value of the energy saved?
(c) What non-energy benefits and cost occur?
(d) How large an investment is required including all retrofit costs?
(e) What are the associated risks?
(f) Will the rates of return vary from one installation to another?

Measures that passed screening requirements were then used to determine the industry target.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

A. *Required return on investments.* Insufficient capital in the petroleum and coal products industry is available for all investments with risk adjusted rates of return above the industry's long-term cost of capital. Energy conservation investments must, therefore, compete with other investment opportunities for a limited amount of available discretionary capital. Conservation investment opportunities, for the short-term target of January 1, 1980, must compete with capital investment having an after taxes return of about 20 percent (hurdle rate). Small and undiversified refiners report even higher hurdle rates. While long-term investment returns may be based on the long-term average cost of capital within the industry, short-term investments must insure higher rates of return to be attractive as discretionary investments.

B. *Capital spending priorities.* In addition to the insufficient supply of capital within the petroleum and coal industry for discretionary investment, higher priorities for investment are often assigned to projects other than energy conservation, such as the following:

1. *Plant maintenance.* The return on plant maintenance is equal to the return on the entire plant but some maintenance replacements can be made with more efficient components.

2. *Conversion.* Shortage of natural gas have raised the priority of conversion installations to a very high level.

3. *Refinery capacity expansion.* Expansion in refinery capacity can be a very attractive investment on existing sites. The limited number of sites available for expansion also make such expansions attractive.

4. *Project completion.* The return on investments on projects already started can be viewed as including the returns on money already spent on such projects. Large cost escalations on existing projects often preempt funds desired for other uses.

5. *Government regulations.* Government regulations mandate expenditures for lead phaseout and pollution control.

6. *Sour crudes.* The increasing necessity of using crude with higher sulfur content mandates significant expenditures in refinery desulfurization equipment.

7. *Strategic investments.* Where timing is essential to achieve the expected return, funds for energy conservation may be preempted.

VI. ASSESSMENT OF POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

This appendix will only discuss the major aspects of the assessment of potential energy conservation measures. A detailed treatment of all the potential measures which were considered is given in the target support documents which are available for examination at locations and times specified in the body of this notice.

A. *Potential measures identified.—SIC 2911, petroleum refining.* Sixteen basic categories of potential conservation measures were identified for the petroleum refining industry. Within these categories, approximately 90 specific measures were considered for technological feasibility first and subsequently for economic practicability as explained earlier. The basic categories are listed below:

1. Improvement in process heater efficiencies.
2. Improvement in boiler efficiency.
3. Steam system improvements.
4. Heat exchanger applications.
5. Air coolers.
6. Insulation.
7. Improvement in fractionation efficiency.
8. Improvement in pump and compressor efficiency.
9. Vacuum system improvements.
10. Pressure energy recovery from process streams.
11. Instrumentation and computer control.
12. Process heat integration.
13. Miscellaneous process developments and modified operating techniques.
14. Refinery loss control.
15. Improved waste heat recovery.
16. Housekeeping measures.

SIC 2951, paving mixtures and blocks. Nine basic categories of potential conservation measures were identified for the paving mixtures and blocks component:

1. Reduced moisture content of aggregate.
2. Improved efficiency of aggregate heating and drying.
3. Reduction in mixing temperatures.
4. Reduction in the use of diesel oil as a truck bed release agent.
5. Reduction in the use of cutbacks.
6. Use of coal to fire dryers.
7. Waste heat recovery.
8. Mix recycling.
9. General housekeeping and loss control.

SIC 2952, asphalt felts and coats. Four major potential measures were identified for the asphalt felts and coats component:

1. General housekeeping.
2. Improved furnace combustion control.
4. Low-energy content fume control.

SIC 2992, lubricating oils and greases. Four major potential measures were identified as follows for lubricating oils and greases componet:

1. General housekeeping.
2. Heat recovery projects.
3. Better oil/sludge separation.
4. New process techniques.

Several additional measures were identified for lubricating oils and greases compounding:

1. General housekeeping.
2. Insultation of tanks and buildings.
3. Improved kettle designs.
4. Improved heat recovery.

SIC 2999, miscellaneous products of petroleum and coal. Since this is a "catchall" category covering many products, attention was focused on the major activity which is the manufacture of calcined petroleum coke. Four major measures were analyzed for this component:

1. Better control of combustion and general housekeeping.
2. Recycle of fines to improve gas emissivity.
3. Process modifications.
4. Waste heat recovery.

B. *Efforts to reduce consumption of petroleum products and natural gas.* Natural gas curtailments are already a major factor in some geographic areas, and risks of curtailment have encouraged early investment in oil-fired capability in the petroleum industry. Some refining companies have indicated that their use of purchased gas could be ended by 1980. It is estimated that about 60 percent of the refining industry will have oil firing capability by 1980 compared to about 20 percent in 1972.

Conversion from natural gas has several important consequences for the refining industry. First, there is a loss of energy efficiency of 3 to 5 percent as a result of changing to less efficient converted units. In addition where low cost natural gas contracts are not met because of allocation quotas, energy prices will rise dramatically due to

use of standby fuels. Conversion installations compete for scarce capital resources with energy conservation proposals. However, unit downtime for conversion installations allows time for conservation installations also without any incremental loss of production. Conversion of oil- or gas-fueled process units to coal fuel is presently considered impractical because of the relatively small sizes of process units which make coal firing impractical and also because most processes used in petroleum refining require more precise temperature control than it is possible to achieve with coal fired units.

V. PROPOSED TARGET DEFINITION

A. *Component goals.* The detailed evaluation of the best available information resulted in the following gross energy efficiency improvement goals for each of the four-digit classifications in SIC 29:

SIC:		Component goal (percent)
2911	Petroleum refining	19.4
2951	Paving mixtures and blocks	47.0
2952	Asphalt felts and coatings	26.0
2992	Lubricating oils and greases	25.0
2999	Miscellaneous products of petroleum and coal	25.5

B. *Proposed two-digit gross target.* The two-digit overall gross target for the petroleum and coal products industry was derived by calculating the weighted average of the component goals in respect to the total energy consumed by each component for the year 1972. The Bureau of Mines' data for 1972 for input volume and energy consumed was utilized for SIC 2911 since the Bureau of Census' data on energy consumption published every five years does not include data on fuels produced and consumed in the same plant. Census of Manufactures' data was used for the other four components as collected in 1971 without adjusting to 1972. The error introduced is negligible since only 2 percent of the total energy in SIC 29 was consumed by these four components. Calculations and data for the gross target development are provided below:

Gross target development

	SIC No.					Total
	2911	2951	2952	2992	2999	
A-base year energy use in 10^{12} Btu	2,994.3	25.97	19.20	5.46	7.5	3,052
B-component goals	19.4	47.0	26.0	25.0	25.5	[1] Tg
A times B	58,035	1,220	499	136	191	60,081

[1] Tg = gross energy improvement target = $\frac{60,081}{3052}$ = 19.7 pct.; use 20.0 pct.

C. *Special circumstances effect.* The refining industry represented by SIC 2911 was fully evaluated for special circumstances which would affect the industry target. The evaluation of the other four-digit classifications did not yield as much usable data. The component offsets due to special circumstances were developed from the results of available data, and, where data was sparse, by technical judgement. The result was the development of the following offsets to the gross component goals:

	(In percent)	
SIC 2911 Gross component goal		19.4
(a) Debit for more energy to refine the crude mix projected for January 1, 1980	2.8	
(b) Debit for additional water pollution control energy	(1)	
(c) Debit for additional air pollution control energy	4.7	
(d) Debit for lesser efficiency of process units converted from natural gas to heavy liquid fuel	.3	
Subtotal debits	7.8	−7.8
Net component goal		11.6
SIC 2951 gross component goal		47.0
Debit allowance/special circumstances	5.0	−5.0
Net component goal		42.0
SIC 2952 gross component goal		26.0
Debit for air and water pollution control and OSHA	17.5	−17.5
Net component goal		7.5
SIC 2992 gross component		25.0
Debit allowance/special circumstances	5.0	−5.0
Net component goal		20.0
SIC 2999 gross component goal		25.5
Debit allowance/special circumstances	5.0	−5.0
Net component goal		20.5

[1] Negligible.
[2] An allowance was established in lieu of data for special circumstances on the basis of technical judgement.

D. *Proposed two-digit net target.* The proposed net target for SIC 29 was developed in a similar manner to the proposed gross target but utilizing net component goals as developed above.

Net target development

	SIC No.					Total
	2911	2951	2952	2992	2999	
A-base year energy use in 10^{12} Btu	2,994.3	25.97	19.20	5.46	7.5	3,052
B-net component goals	11.6	42	7.5	20	20.5	[1] T_n
A times B	34,726	1,090	145	109	154	36,536

[1] T_n = net energy efficiency improvement $\frac{36,536}{3052}$ = 12 pct. target.

VI. FINAL TARGET DEFINITION

A. *Comments and impact on proposed target.* Comments on the draft target were received at a public hearing conducted by FEA on December 2, 1976, and additional written comments were subsequently received by FEA. Where many comments addressed similar issues, they have been summarized and answered as a group. All the comments referred to the SIC 2911, petroleum refining component, except one which addressed the SIC 2952, asphalt felts and coatings component. During the public comment period, there were a number of questions concerning the difference between the target proposed under the EPCA program and the target established under the prior FEA/DOC industrial efficiency program. The 15 percent target established under the latter program is a gross target set in 1974, and the impact of special circumstances was not isolated. The proposed offsets for special circumstances cover essentially the same type of operations as the industry program. The final offsets developed later in this document retain this identity. The net target value can be more easily understood if it is considered to be the result of measured energy use divided by the measured units of production to yield a ratio of energy units in Btu per production unit to compare with the base year ratio.

Some comments indicated concern that some individual companies would be unable to achieve the target reduction in energy consumption. The target is a weighted average and reflects a goal for the entire SIC 29 industry. The target is not intended to represent a maximum or a minimum effort by any particular company.

The fact that some firms have been more aggressive than others in completing energy conservation installations prior to the base year 1973 was pointed out in many comments. The contribtuions of the conservation measures to the target did take recognition of that fact in order to evolve a meaningful target value.

Setting targets on the basis of a specific Btu per barrel improvement for a refinery was proposed by some commenters in place of a percentage target. While this suggestion has theoretical merit, it would be cumbersome to apply because of the need to establish some standard on an industry wide basis. For this reason, as well as to provide consistency with the targets for other industries, the percentage method was chosen.

Many comments pointed out the value of the adjustment factors utilized in the American Petroleum Institute voluntary reporting system form. The API system is comprehensive and provides adequately for changing conditions. It is the opinion of FEA that its target setting procedure uses similar and fully adequate factors for determining offsets.

While the development of the draft target value was made without consideration of any future legislative action to provide financial incentives for the installation of energy saving measures, passage of such legislation would certainly require a re-examination of the target. Such review is provided for by section 374(d) of EPCA.

Some commenters pointed out the possibility that current progress in conservation was accomplished by installing the easiest and least expensive measures first, leaving the more difficult and expensive measures to the future. This situation was recognized by FEA while setting the draft target values.

It is apparent that some commenters misunderstood the original proposed target as to whether the petroleum industry component goal was based on input or output to the refinery. Since the petroleum refining industry measures energy use in Btu's per barrel or feedstock fed into the refinery, and since this method is used in the voluntary industry re-

porting program, FEA's target is based on input activity to the refinery.

Some comments remarked that the percentage emphasis placed on housekeeping as a potential conservation measure was too great while others suggested it was too small. After re-examining the detailed data obtained from the industry, FEA concluded that the proposed figure was reasonable since no new data of a substantive nature was presented. Similarly, a divergence of opinion was received on the potential contributions to energy conservation of process heat integration and new capacity additions. Again no change was felt to be justified in the original evaluation results, since no substantive data was submitted to correct the proposed figure.

Some concern was voiced on the selection of 10,000 Btu per kwhr as the conversion factor for electricity. This value includes the heat energy to generate the electricity. The voluntary program sponsored by API uses this same conversion factor. The 3,412 Btu per kwhr factor is used only with Bureau of Census data and is the theoretical heat content of one kwhr.

One comment suggested rejecting the inclusion of loss recovery as an energy efficiency improvement measure. Since loss recovery represents a yield improvement rather than an energy efficiency improvement it is suggested by FEA that loss recovery should improve in energy efficiency. t is obvious that loss recovery as practiced in the industry requires a different type of technology than that normally applied to energy efficiency improvement in manufacturing processes. In addition, the possibilities of abusing the item if used as a credit against efficiency are significant.

Much controversy surrounds the values assigned as offsets for such items as product mix changes, feed quality changes, lead phase-down, and environmental control requirements. It is therefore, important to address the many valuable comments received on this subject. Offset values are by definition highly variable and are not under the control of the industry. Since the net target value is the result of subtracting the total offsets from the gross target it is necessary to examine the comments received on particular offsets.

(a) Crude mix changes: An increase in offset value from 2.8 percent to 3.0 percent was considered justified in the light of comments received on company-specific crude import projections. Crude slate changes can be influenced by factors not wholly under the control of the industry, but current industry projections on sulfur levels and heavier average crude mix were used in the adjustment as a rational basis for considering the future average quality of crude.

(b) Gasoline lead levels: It now appears that an overall lead level of 0.5 oc per gallon will be in effect by 1980 indicating a severe energy consumption penalty of about 4.5 percent which can be partially reduced by the use of a government approved non-lead octane improver, to about 3.0 percent. Any major change in these factors will result in a significant change in energy consumption in the industry by the target date.

(c) Air pollution control: Industry commenters seriously questioned the 4.7 percent offsets proposed for air pollution control as being too high. This calculation was based on a specified mix of sulfur-removal and tail-gas scrubbing processes being installed by 1980. On review, it was decided that the increased use of energy efficient processes would reduce the amount of energy consumed, and the offset was reduced to 2.1 percent.

(d) Conversion from natural gas: No change was justified in this offset value, and it remained at 0.3 percent.

(e) In addition some consideration was given to an offset for product mix and demand changes. Changes in the production of light products such as gasoline, and reductions in imports projected for 1980 will generally require additional energy for refining. A continuing success in yearly improvement in motor car fuel mileage is assumed as a basis for the 1980 projections, and it was concluded that no major offset would result from product mix changes over and above the offset already accounted for as a crude mix change effect.

No offset was considered appropriate for demand changes.

The final offset totals for SIC 2911 are:

	Percent
Crude mix changes	3.0
Lead phase-down	3.0
Air pollution control	2.1
Conversion from natural gas	0.3
Total	8.4
Use	8.0

One comment on SIC 2952, (asphalt felts and coatings) expressed concern that sufficient recognition be awarded to necessary non-discretionary offsets for this industry, including new energy intensive, pollution control requirements and changes in raw materials specifications. Recognition was given in the final offset value for this component to account for these factors.

B. *Final target value.* While the evaluation of comments resulted in some reallocation of offset values, the total value of offsets remained unchanged from the draft target value. There were no comments received and evaluated that resulted in any change in the gross target value and therefore it remained at 20 percent. The 8 percent offsets for SIC 2911 was then applied to the entire SIC 29 industry due to the overwhelming weight of energy consumed by that component.

The impact of the gross target of 20 percent on the industry total consumption of energy in 1980 as compared to 1972 is as follows for SIC 29:

(1972 refining energy=685,400 Btu/bbl.)
1972 total consumption at 685,400 Btu/bbl and 11.7 MMbbl refining input=2.99×10^{15} Btu.
1980 Total consumption at 80 pct.×685,400 Btu/bbl and 15.7 MMbbl (SIC 2911 portion=98 pct.

$$=\frac{548,300\times15.7\times10^{6}\times365}{0.98}=3.21\times10^{15}\text{ Btu.}$$

It is seen that while refinery input is increased by 34 percent from 11.7 MMBPD to 15.7 MMBPD that the total energy consumption will increase only by 7.3 percent from 2.99 quads to 3.21 quads.

The gross energy savings in the target year alone with achievement of the 20 percent target would be:

$$\frac{(20\text{ pct}\times685,400)\times15.7\times10^{6}\times365}{0.98}=$$

0.8×10^{15} Btu's=0.8 quads

The final SIC 28 two-digit target, therefore, was arrived at as follows:

	Percent
Gross target (based on maximum energy efficiency achievable without consideration of special circumstances or conditions of the industry)	20
Offset (required for special industry circumstances and conditions)	8
Net target (based on maximum efficiency achievable with consideration of special circumstances and conditions)	12

Appendix F: Statement of Basis and Justification for the Energy Efficiency Improvement Target for SIC 32—Stone, Clay, and Glass Products

I. Industry Description and Energy Base

The stone, clay, and glass products industry, Standard Industrial Classification (SIC) 32, is a grouping of 27 four-digit product classifications. The following table illustrates the approximate energy consumption for each of the four-digit classifications during the base year:

SIC	Industry	1972 energy consumed, 10^{15} Btu's	Percent
3241	Hydraulic cement	504.8	34.5
	Glass products:		
3211	Flat	70.2	4.8
3221	Container	150.9	10.3
3229	Pressed and blown	79.0	5.4
3296	Mineral wool	51.3	3.5
3231	Purchased glass	17.0	1.2
3274	Lime	106.0	7.3
	Structural clay products:		
3251	Brick and tile	92.9	6.4
3259	Products, NEC	27.9	1.9
	Concrete products:		
3271	Block and brick	19.5	1.3
3272	Products, NEC	32.6	2.2
3273	Ready mix concrete	82.0	5.6
3275	Gypsum	49.2	3.4
	Refractories:		
3255	Clay	25.5	1.7
3291	Nonclay	13.6	.9
3297	Abrasives	37.3	2.6
	Whiteware products:		
3253	Wall and floor tile	7.2	.5
3261	Plumbing fixtures	9.7	.7
3262	Vitreous china	3.3	.3
3263	Earthenware	3.0	.2
3264	Electrical porcelain	7.4	.5
3269	Pottery, NEC	4.7	.3
	Mineral products:		
3281	Cut stone	6.1	.4
3292	Asbestos	15.5	1.1
3293	Gaskets	7.4	.5
3295	Minerals	27.9	1.9
3299	Products, NEC	9.9	.7

Energy sources for SIC 32 in 1972 were:

Form of energy	10^{15} Btu	Percent of total
Fuel oil	146.2	10
Natural gas	818.6	56
Coal, coke	263.1	18
Electricity	102.3	7
Other	131.6	9
Total	1,461.8	100

While these product classifications rely on a variety of manufacturing processes, similarities among products or processes permitted the grouping of the 27 four-digit classifications into the following nine major categories to facilitate the required analysis:

1. *Hydraulic cement.* SIC 3241 includes companies primarily engaged in manufacturing hydraulic cement, including portland, natural, masonry, and pozzolan cements.

2. *Glass products.* SIC 3221, 3211, 3229, 3296, and 3231 group companies engaged in the manufacture of glass and glassware including flat glass, glass containers, mineral wool (including fiberglass insulation), and products made from purchased glass.

3. *Lime.* SIC 3274 describes companies which manufacture quicklime, hydrated lime, and "dead-burned" dolomite from limestone, dolomite shells, or other substances.

4. *Structural clay products.* SIC 3251 and 3259 includes manufacturers of brick and structural clay title, and clay sewer pipe.

5. *Concrete products.* SIC 3273, 3271, and 3272 includes companies which manufacture concrete building block and brick and other products from cement and aggregate; and companies which manufacture and deliver portland cement concrete in a plastic and unhardened state.

6. *Gypsum.* SIC 3275 includes manufacturers of plaster, plasterboard, and other products composed wholly or chiefly of gypsum.

7. *Refractory and abrasive products.* SIC 3255, 3297, and 3291 includes companies which manufacture clay and nonclay refractories and abrasive products.

8. *Whiteware products.* SIC 3261, 3264, 3253, 3269, 3262, and 3263 include companies which manufacture china and earthenware articles,

porcelain electrical supplies, and ceramic wall and floor tile.

9. *Mineral products.* SIC 3295, 3292, 3291, 3293, and 3299 include companies which manufacture gaskets, compression packings, molded packings, oil seals, mechanical seals, commodities composed wholly or chiefly of asbestos (except asbestos paper), and other nonmetallic mineral products, as well as companies which operate without a mine or a quarry and specialize in crushing, grinding, pulverizing, or otherwise preparing clay, ceramic, and refractory minerals and companies which cut, shape, and finish marble, granite, slate, and other stone for building and miscellaneous uses.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

A large number of potential energy conservation measures were considered. Each potential measure was evaluated in regard to its acceptance on the basis of technological and economic feasibility. The measures which were screened and the results of the screening process are given in Section IV below.

A. *Technological feasibility.* Each potential conservation measure was evaluated according to the following criteria to determine if it was technologically feasible:

1. Could the measure be implemented in time to have an impact on energy consumption by January 1, 1980?

2. Could the measure provide significant energy savings within an industry component; would such savings have an impact on SIC 32 energy consumption?

3. Has the measure been demonstrated commercially in the U.S. by 1975 (if it required significant process modifications or equipment additions), or has the measure been demonstrated commercially in a foreign country?

Each measure was further screened against the following criteria:

1. Could the measure lower the quality of the product produced to an unmarketable level?

2. Could the measure decrease production rates to a noncompetitive level?

3. Could the measure cause an undesirable interaction with other measures?

B. *Economic practicability.* An after-tax discounted-cash-flow return on investment analysis based on the following assumptions was used to evaluate the economic practicability of those technically feasible measures:

1. Project life was fixed at 10 years (with some exceptions).

2. A single initial capital investment was assumed.

3. A straight-line depreciation rate over the life of the project was allowed.

4. Fuel costs were set at $2.50/million Btu for fossil fuels and $7.50/million Btu equivalent for electrical power.

5. Unless otherwise specifically identified as a substantial change, all changes in cost of labor, power, maintenance, and supplies were considered to be offsetting and to result in negligible changes in operating costs.

6. A 50 percent effective federal and state tax rate was used, and all other taxes and tax credits were assumed to be offsetting or negligible.

7. The hurdle rate for return on investment (ROI) was set at 15 percent based on industry practice.

Several other simplifying assumptions were implicit in the return on investment analysis. Production capacity and operating dollars were assumed to be constant. The installed capital cost of a proposed project was based on costs of actual projects completed in the 1974–1975 period or engineering estimates of the installed costs where actual project data were not available.

The return of investment analysis produced a set of economically feasible conservation measures.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

The set of technically and economically feasible measures was further screened for the availability of capital within SIC 32 to obtain an optimum set of measures upon which to base the target. The results of the return on investment analysis are outlined first in this section and then the availability of capital is considered. The results of this final screening are those measures discussed in Section IV

A. *Required return on investments.* Most of the technically feasible energy conservation measures fell into one of two groups. In the first group, the rate of return was above 25 percent, a figure substantially in excess of the industry hurdle rate of 15 percent. The other group contained potential measures whose calculated rate of return was under 5 percent. These latter measures were not economically practicable. In the few situations where the calculated return on investment was close to the 15 percent hurdle rate, the sensitivity of the ROI to the assumed capital investment was examined in the final assessment of the economic feasibility of a given energy conservation measure.

B. *Capital spending priorities.* The next question that was considered in arriving at an evaluation of the economic practicability of a given measure was the availability of the capital funds required to implement it.

Every industry regards investment for energy conservation as one of a number of alternative demands on the available capital funds. If a proposed investment offers a sufficiently high return on investment, it will be considered further and will be evaluated with respect to the current priorities and strategy of the business. Investments which are generally considered to take priority over energy conservation investments include those required to:

1. Comply with laws and regulations.
2. Ensure the immediate survival of the business.
3. Maintain market share.
4. Assure supplies of essential raw materials or energy.
5. Expand production capacity to provide for anticipated growth.

Energy conservation is usually in the deferable category to be funded from any surplus left after non-discretionary investments have been budgeted. The size of this discretionary fund was determined by first estimating the total amount of money available to each component industry for capital investments during the period 1972–1980. Data on past investment levels from the Annual Survey of Manufacturers published by the U.S. Department of Commerce, Bureau of the Census, were used as the indicator of the ability of the industry to generate and borrow capital for new plants and equipment. From the aggregated financial capability of SIC 32, allocated, estimated, and projected expenditures during the target period, including expenditures for capacity increases, compliance with environmental and other regulations, assuring supplies of raw material and energy (including conversion to less scarce energy forms), and for any other known high priority, non-discretionary capital expenditure were subtracted. Where the individual data were insufficient for such detailed calculations, it was assumed that the funds available for energy-conserving measures represented 33 percent of the total available capital funds. The amount of remaining funds determined the extent to which the industry could implement the technically and economically feasible energy efficiency improvement measures.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

A more detailed treatment of potential conservation measures can be found in the target support documents which are available for examination as indicated in the body of this notice. The principle measures are listed here by industry group and include measures which were eliminated by either the technological or economic screening.

A. *Potential measures identified.*—1. *Hydraulic cement, SIC 3241.* The following measures contributed to the goal for this component:

(a) Maintenance of kiln seals.
(b) Improved refractories.
(c) Cooling of kiln shell.
(d) Reduction of gas and dust heat loss by using chains.
(e) Reduction of water in feed.
(f) Conversion of dry process kiln.
(g) Conversion to preheater kiln.
(h) Use of alternate raw materials.
(i) Production of blended cement.

Measures considered but eliminated by the screening criteria discussed above included:

(a) Use of new stationary kilns.
(b) Waste heat drying.
(c) Use of roller mills in finish grinding.
(d) Use of grinding aids in finish grinding.
(e) Increasing alkali content of product.

2. *Glass products, SIC 3221, 3211, 3229, 3296 and 3231.* The following measures contributed to the goals for the glass product industry components:

(a) Improved combustion control.
(b) Improved regenerator brick.
(c) Secondary heat recovery.
(d) More efficient lehrs.
(e) Use of waste heat boilers.
(f) Increased furnace insulation.

Measures considered but eliminated included:

(a) Increased electric boosting.
(b) Oxygen enrichment (feasible for mineral wool SIC 3296).
(c) Batch preheating.
(d) All electric melting (feasible for mineral wool SIC 3296).

3. *Lime, SIC 3274.* The following measures contributed to the goal for SIC 3274:

(a) Addition of coolers to kiln.
(b) Use of internal refractory elements.
(c) Conversion to preheater kiln or modern vertical kiln.
(d) Switching to coal as fuel.

Measures considered but eliminated included: (a) Replacement of small kilns with large. (b) Installation of control systems.

4. *Structural clay products, SIC 3251 and 3259.* The following measures contributed to the goals for these components: (a) Kiln modernization. (b) Kiln replacement.

Measures considered but eliminated included: (a) Increased coring of brick. (b) Fuel additives to unburned brick.

5. *Concrete products, SIC 3273, 3271, and 3272.*

The following measures contributed to the component goals:

(a) Conversion from gasoline to diesel for delivery.
(b) Improved fuel economy in delivery.
(c) Improved curing cycle.

Measures considered but eliminated included: (a) Use of continuous cure ovens. (b) Ambient air cure.

6. *Gypsum, SIC 3275.* The following measures contributed to the component goal:

(a) Improved combustion in calcining.
(b) Reduction of stack heat loss.
(c) Conversion from batch to continuous calcining.
(d) Additional or improved insulation.
(e) Reduction of water content of board.
(f) Reduction of bulk density of board.

The following measure was considered but eliminated: (a) Conversion from indirect to direct fired driers.

7. *Refractory and abrasives products, SIC 3255, 3297, and 3291.* The following measures contributed to the refractory product goals: (a) Kiln modernization. (b) Improved kiln utilization.

The following measure was considered but eliminated: (a) Lowered processing water content.

8. *Whiteware products, SIC 3261, 3264, 3253, 3269, 3262, and 3263.* The following measures contributed to the component goals: (a) Kiln modernization. (b) Kiln replacement. (c) Optimization of kiln firing schedule.

The following measure was considered but eliminated: (a) Lowered processing water content.

9. *Mineral products, SIC 3295, 3292, 3281, 3293, and 3299.* The following measures contributed to the component goals:

(a) Improvements in material handling and conveying.

(b) Pyro-processing equipment modification or replacement.

The following measure was considered but eliminated: (a) Ambient air cure.

In addition to the specific measures enumerated above, many general conservation measures referred to as housekeeping contributed to the energy efficiency improvement potential of each industry component.

B. *Efforts to reduce consumption of petroleum products and natural gas.* Since 1972, significant changes have occurred in the emphasis which industry places on energy planning and management. Because of the scarcity of natural gas, there has been some shift in the pattern of energy consumption by SIC 32 industries. Reports submitted as part of the joint FEA-Department of Commerce Voluntary Industrial Energy Conservation Program and the survey of energy usage in 1974 by the Bureau of Census (Annual Survey of Manufactures 1974 Vol. 4.2, Fuels and Electric Energy Consumed) indicate that the use of natural gas is declining and the use of oil and electricity is rising. For instance:

1. The cement reporting group showed a 6 percent decline in the relative gas usage between 1972 and 1975 with a corresponding increase in the use of coal.

2. The refractories reporting group showed a 6 percent decline in the relative gas usage between 1972 and 1974 with a corresponding increase in the use of fuel oil.

3. The flat glass and pressed and blown glass reporting groups showed a 6 percent decline in the relative gas usage between 1972 and 1975, with a corresponding increase in the use of fuel oil.

4. The brick reporting group showed a 5 percent decline in the relative use of gas between 1972 and 1975, with a corresponding increase in the use of fuel oil and coal.

5. The Bureau of Census figures for SIC 32 indicate a 2 percent decline in the relative use of natural gas between 1971 and 1974. Fuel oil usage increased 7 percent while coal usage decreased 4 percent.

For a majority of manufacturers in SIC 32, fuel oil and liquified petroleum gas fuels are the only practical alternatives to natural gas. In some cases, replacing existing processing equipment with electrically heated equipment is also technically feasible. Conversion to coal usually requires an ash-free, and sometimes sulfur-free, combustion product which will not affect product quality. Such coal-firing technology will not be generally available on a commercial basis before 1980; and, therefore, conversion from natural gas and oil by a majority of the SIC 32 industries is not likely to occur.

However, in a few SIC 32 components such as cement, lime and mineral products coal currently represents a higher percentage of the energy consumed than in 1972. The pyro-processing equipment, such as rotary kilns, used in these industries can utilize any fossil fuel, and the product quality specifications can accept the impurities generated by the combustion of the coal. In each case, the conversion is made primarily for business reasons, including the unavailability of natural gas. Securing reliable coal stocks of consistent quality and avoiding emissions which exceed ambient air quality standards are two barriers which can affect the decision to use coal. The conversion to coal in some component industries could increase the relative percentage of energy supplied by that fuel from the 18 percent level in 1972 to a maximum of about 40 percent in 1980. Such conversion, however, is not anticipated to result in any significant reduction in energy efficiency.

V. PROPOSED TARGET DEFINITION

A. *Component goals.* The analyses outlined above and detailed in the target support document resulted in the following energy efficiency improvement goals for each of the four-digit SIC classifications:

Industry group	SIC	A 1980 energy usage (10^{12} Btu) At 1972 efficiency	B 1980 energy usage (10^{12} Btu) At 1980 efficiency	C Component goal (percent)
Hydraulic cement	3241	501.43	423.10	[1] 15.7
Glass product:				
Containers	3221	196.38	171.60	12.5
Flat	3211	85.91	66.82	22.6
Pressed and blown	3229	92.53	74.95	19.0
Mineral wool	3296	62.40	51.79	17.0
Purchased glass	3231	10.10	16.33	20.5
Lime	3274	132.13	113.61	14.0
Structural clay products:				
Brick and tile	3251	108.62	89.23	18.0
Products, n.e.c.	3259	30.23	24.91	17.6
Concrete products:				
Ready-mix concrete	3273	95.80	83.25	13.1
Block and brick	3271	22.96	19.08	16.6
Products, n.e.c.	3272	28.16	24.59	9.4
Gypsum	3275	51.56	43.97	14.7
Refractory products:				
Clay	3255	33.00	28.13	15.0
Nonclay	3297	48.96	44.08	10.0
Abrasives	3291	17.23	14.61	15.0
Whiteware products:				
Plumbing fixtures	3261	11.38	9.67	15.0
Electrical porcelain	3264	9.08	7.71	15.1
Wall and floor tile	3253	7.87	6.92	12.1
Pottery, n.e.c.	3269	5.07	4.31	15.0
Vitreous china	3262	3.54	3.09	13.1
Earthenware	3263	2.21	1.79	19.0
Mineral products:				
Minerals	3295	33.99	29.15	14.2
Asbestos	3292	18.18	15.15	16.7
Cut stone	3281	7.16	5.27	26.4
Gaskets	3293	9.33	7.96	14.7
Products, n.e.c.	3299	12.02	11.56	3.8
Total		1,752.60	1,462.45	[2] 16.55

[1] Final SIC 3241 goal=15.7 pct.
Final SIC target=15.68 pct (rounded off to 16 pct).

B. *Proposed two-digit gross target.* The SIC 32 proposed gross target is the percentage reduction in energy consumed per unit of output from the base year (1972) to the target year (1980) without consideration of special circumstances. Aggregating the component energy efficiency goals into a proposed gross energy efficiency improvement target for the entire stone, clay, and glass industry was accomplished by weighting the contribution of each component in terms of its relative total energy consumption. This involved estimating for each of the 27 components:

(a) Energy per unit of output consumed in 1972.

(b) Technologically feasible means to improve energy utilization.

(c) What fraction of the above means would be implementable by January 1, 1980, based on economic practicability.

(d) A forecast of 1980 output.

(e) Energy consumption in 1980 at 1972 efficiency.

(f) Energy consumption in 1980 at 1980 efficiency.

(g) Energy savings in 1980 by implementation of 1980 efficiency improvement means.

(h) Item (g) divided by Item (e), expressed as a percentage.

The percent reduction in energy consumed per unit of industrial output was calculated by dividing 290.14×10^{12} Btu, the energy saved by the use of conservation measures, by the 1980 energy consumption at 1972 efficiencies (1752.60×10^{12} Btu). The proposed gross target for energy efficiency improvement in SIC 32 which was determined to be technically and economically feasible was 17 percent.

C. *Special circumstances effects.* In the case of SIC 32, the proposed gross target also represented the net energy efficiency improvement target because special circumstances affecting the industry were judged to have no impact on future energy consumption which would affect the target value.

The significant capital investments that have already been made by the industry for pollution control equipment and the anticipated additional expenditure in the 1976–1980 period were taken into account in assessing the funds available to finance energy-saving capital projects. While the amount of energy consumed in operating pollution control equipment was examined, FEA concluded that the operations of existing pollution control equipment has caused negligible increases in energy consumption. Any future increases in energy consumption resulting from equipment installed to meet 1977 environmental standards will be off-set by gains in energy efficiency resulting from more efficient process equipment installed to meet growing market demand.

D. *Proposed two-digit net target.* The proposed net target for SIC 32 was 17 percent, the same as the proposed gross target.

VI. FINAL TARGET DEFINITION

A. *Comments and impact of proposed target.* Testimony given at the December 9, 1976, public hearing conducted by FEA and timely written comments received by FEA on the proposed target for SIC 32 were reviewed by FEA. Where different comments addressed similar issues, they have been summarized and responded to below as a group.

Some comments were concerned with the difficulty in achieving the energy efficiency improvement goals of certain components in view of the limited progress made toward those goals since 1972 and the short time remaining until January 1, 1980, in which to undertake the extensive capital equipment modernization program on which the improvement was based. Section 374(a)(2) of the EPCA provides that each target shall be established as the maximum feasible improvement which can be achieved by January 1, 1980, and FEA has no discretion in setting targets outside the statutory requirements.

Several comments disagreed with the energy consumption figures for the base year 1972. After evaluating these comments FEA concludes that the data used in this study, which were derived from the U.S. Bureau of Census data, represent the best information available for the whole industry.

Several comments concerned the possibility that energy consumed by one four-digit classification was incorrectly attributed to another classification, or that potential energy conservation measures were incorrectly attributed to one component that properly should be attributed to one or more different industry components. Two comments concerned the possible inclusion in figures for consumption for SIC 32 components, of the energy required for the capitive production of SIC 32 products as raw materials by industries outside SIC 32. FEA has carefully reviewed the data applicable to those comments and has concluded that the original data were accurate.

Eight comments were concerned with the actual achievement of component goals or the industry target by individual companies. The component goals represent the maximum feasible improvement, as determined by FEA, for the industry components. No goals were developed for individual companies. The industry target is a weighted average of the component goals and is not intended to be indicative of the potential of an individual company.

A substantial area of concern by commenters was the degree to which individual measures for improving energy efficiency are applicable throughout an industry component and the extent to which various combinations of measures can be aplied within an individual plant or company. Some comments disagreed with the target support document on the extent to which specific measures were applicable. The grounds for this disagreement included (a) differing judgments concerning the extent to which a measure had been applied prior to 1972, (b) potential adverse effects on product quality for some markets, (c) potential increases in operating or maintenance costs, (d) potential increases in production rate and (e) limitations on raw materials choices imposed by the measure. Two comments questioned whether the energy savings to be achieved by installing a combination of measures had been properly evaluated because the net savings from a combination could be significantly less than the sum of the individual savings. Four comments questioned whether the degree of energy savings potential for specific measures could be achieved throughout the industry component.

In fact, these considerations were an intrinsic part of the analysis of potential conservation measures and had been carefully considered in the judgments made concerning technical feasibility, the applicability of the technical measures alone and in combination, and the average energy efficiency improvement attainable by various measures. In many cases, the objections of comments were based on the experience of an individual company or a segment of the industry component and are not representative of the entire component.

The economic practicability of individual measures on the plant and component-wide basis was another area which generated negative comments. These comments addressed the following issues: the estimates of capital costs of the plant and equipment modifications, the fuel costs assumed, and the ability of the industry component to generate the amount of capital needed to achieve the level of implementation included in the target.

Three comments questioned the validity of the estimated capital cost figures used in the return on investment calculations for certain equipment modifications or replacements. The capital cost figures used were based on reports in the technical literature, or data from individual companies concerning the costs of actual plant modernization projects completed during 1972–1975 and estimates by engineering firms, construction firms, and equipment suppliers of the costs of various modifications for which actual costs were not available. The higher cost figures stated in some of the comments represented the experience of a few companies or estimates of future construction costs and are no more reliable indicators of the probable costs for the entire industry than the figures used by FEA in the return on investment calculations. Because of the significant use of data from actual modernization projects, the economic feasibility of those projects was not overestimated.

Three comments questioned the accuracy of the fuel cost estimates used to develop the target. The fuel cost used in developing the SIC 32 target was an estimated average of industry fuel costs during the period 1972 to 1980. After considering the data presented on fuel costs FEA determined that the fuel cost estimate used was reasonable for all industry components except the cement industry. The cement industry, unlike most of SIC 32, has been able to make a substantial conversion to coal and to stabilize fuel costs for 1972–1980 at about half the fuel cost used in developing the target. The economic motivation for capital investment by the cement industry is correspondingly likely to be lower than was originally estimated. The maximum practicable rate of modification and replacement involving high capital cost investments is therefore lower for the cement industry. Because of the substantial energy consumption of the cement industry these changes will have an impact on the proposed target value.

Two comments questioned the ability of two components to generate sufficient capital funds to finance sufficient plant and equipment modifications as called for in the support document. The revised evaluation of the cement industry as a result of its lower fuel costs substantially reduces its projected need for capital funds, and the ability of the cement industry to generate sufficient funds at the lower level of investment is more than adequate on the basis of past data. Careful consideration of the other comment revealed that the statement was based on hypothetical future development and did not warrant any change in the goal for that component nor in the target.

Three comments questioned whether the potential dicrease in efficiency as a result of a decline in production had been sufficiently accounted for in determining the energy efficiency improvement potential for their particular industry component. Consideration of those comments and a re-examination of the limited data available on the relationship between production and energy efficiency in SIC 32 industries did not result in a change of the original conclusions concerning the probable future impact of market conditions on production and energy efficiency in SIC 32. However, unanticipated future decreases in product demand in the stone, clay and glass industries could have a significant effect on energy conservation and offset much of the improvement achieved by measures implemented on the assumption of continued growth. As provided for by the EPCA Section 374(d), the target may be modified by FEA if conditions warrant.

Six comments concerned special circumstances and questioned whether these had been adequately considered in determining the industry target. Two comments concerned the increased energy consumption which results from the operation of pollution control equipment. The data presented represented the experience of an individual company and predictions for possible future requirements, and are not valid with respect to the whole industry. Three comments questioned whether the assumption that conversion to coal would not affect energy efficiency was valid for their industry component. FEA concluded that significant conversion to coal firing would take place only in those industry components where such conversions would not be detrimental to either product quality or production rate and would not adversely affect energy efficiency, that is in the cement industry and portions of the lime, refractories, structural clay products, and expanded minerals industries. If conversions beyond those do occur a decrease in energy efficiency could result. The EPCA provision for target modification allows for appropriate changes if this should prove to be the case in the future. One comment concerned the energy penalty associated with quality specifications that limited the application of a specific energy efficient equipment modification. This limitation had been accounted for in assessing the applicability of this equipment. If product specifications should be altered in the future, the effect on the component goal and its potential impact on the target could be appraised during a review of the target.

B. *Final Target.* Based upon a comprehensive review of the proposed target document and the comments received by FEA, the SIC 32 energy efficiency improvement target has been revised.

Two changes occurred in the component goal for the cement industry and these resulted in a 14 percent reduction in the expected improvement for this industry component (from 18.3 to 15.7 percent). These changes were (1) a reduction in the estimate for the maximum economically practicable rate of conversion or replacement of kilns due to a lower cost of fuel than originally assumed, and (2) inclusion of energy savings resulting from the addition of new, more efficient plants and equipment to increase industry capacity. These two changes reduced the SIC 32 draft target from 290.14×10^{12} Btu to its final value of 274.77×10^{12} Btu. No other changes were made which had an impact on the final SIC 32 target.

The final target arrived at is 16 percent. This is calculated by dividing the 1980 energy efficiency improvement of 274.77×10^{12} But by the 1980 energy consumption at 1972 efficiencies of 1752.60×10^{12} Btu, and rounding to the nearest integer.

The impact of the target on the industry's total consumption of energy in 1980 as compared to 1972 is as follows for SIC 32:

1972 total consumption = 1462×10^{12} Btu
1980 total consumption = 1478×10^{12} Btu (provided the target is attained)

The following is the energy efficiency improvement target set by FEA for SIC 32:

APPENDIX G: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 33—PRIMARY METAL INDUSTRIES

	Percent
Gross target, based solely on technological feasibility and economic practicability	16
Offset, based on consideration of special circumstances	0
Net target, based on technological feasibility and economic practicability plus consideration of special circumstances	16

APPENDIX G: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 33—PRIMARY METAL INDUSTRIES

I. INDUSTRY DESCRIPTION AND ENERGY BASE

The primary metal industries group comprising Standard Industrial Classification (SIC) 33 consists of 26 four-digit product classifications. These classifications are shown below with the figures for 1972 energy consumption.

SIC	Industry	1972 energy consumed 10^{12} Btu's	Percent
3312	Blast furnaces, coke ovens, steel works, rolling mills	3,063.0	72.14
3315	Steel wire, nails, spikes	14.0	.33
3316	Cold rolled steel sheet, strip and bars	13.0	.31
3317	Steel pipe and tubes	15.0	.35
3334	Primary aluminum	491.4	11.57
3353	Aluminum sheet, plate, foil	56.6	1.33
3354	Aluminum extruded products	24.4	.58
3355	Aluminum rolling and drawing, not elsewhere classified	15.1	.36
3321	Gray iron foundries	180.3	4.07
3322	Malleable iron foundries	9.6	.23
3331	Primary copper	66.6	1.57
3351	Copper rolling, drawing, extruding	17.7	.42
3313	Ferroalloys	75.0	1.77
3361	Aluminum foundries	22.6	.53
3362	Brass, bronze, copper foundries	3.4	.08
3369	Nonferrous foundries, not elsewhere classified	10.0	.24
3324	Steel investment foundries	.6	.01
3325	Steel foundries, not elsewhere classified	42.4	1.00
3339	Other primary nonferrous	43.0	1.01
3356	Rolling, drawing, extruding nonferrous	12.7	.30
3357	Drawing and insulating nonferrous wire	22.8	.54
3398	Metal heat treating	27.1	.64
3399	Primary metal products, not elsewhere classified	7.4	.17
3341	Secondary nonferrous smelting and refining	33.0	.78
3333	Primary zinc	21.0	.50
3332	Primary lead	9.0	.21
	Total	4,246.0	100.00

The above data indicates that a reduction in energy consumption by SIC 3312, the four-digit classification covering the basic steel industry, will have an extremely substantial effect on energy consumption by the whole industry, since this classification alone accounts for over 70 percent of the energy consumption of the primary metal industries. The energy sources for the SIC 3312 classification of the steel industry are shown below with the tons of production and energy per unit of production for 1972.

Survey on 1972 net energy consumption in the steel industry [1]

Form of energy	10^9 Btu	Percent of total
Coal (metallurgical)	1,654,338,621	60.4
Coal (boiler)	69,218,661	2.5
Coal (other)	6,906,431	.3
Natural gas	596,818,042	21.8
Middle distillates	12,756,385	.5
Residential fuel oil	172,340,417	6.3
Other petroleum products	2,446,805	.1
LP gas	1,288,519	.1
Electricity (purchased)	115,745,487	4.2
Coke (purchased)	105,420,228	3.8
Coke oven gas (purchased)	3,656,860	.2
Tar or pitch (purchased)	513,000	
Other	142,000	
Total Btu's	2,741,601,456	100.0

Total finished steel produced,[2] 84.05×10^9 net tons.
Btu consumption per net ton of finished steel produced, 32.61×10^6.

[1] Survey companies accounted for 89.5 pct of total industry production in 1972.
[2] Shipments adjusted for inventory changes.

Energy consumption for major steelmaking unit operations—1972 base year

	10^6 Btu per net ton of finished steel produced	Percent of total energy used
Coke ovens	3.7	11.3
Blast furnace	19.7	60.5
Steel furnaces	2.2	6.7
Soaking pits, reheat furnace, annealing, and heat treatment	4.8	14.7
Rolling and finishing operations	2.2	6.8
Total	32.6	100.0

Primary metal industries include establishments engaged in the smelting and refining of ferrous and nonferrous metals from ore, pig, or scrap; in the rolling, drawing, and alloying of ferrous and nonferrous metals; in the manufacture of castings and other basic products of ferrous and nonferrous metals; and in the manufacture of nails, spikes, and insulated wire and cable. This industry also includes the production of coke.

For the purpose of establishing the gross target, the four-digit classifications were grouped into 13 components according to the following guidelines:

1. the form in which data were available.
2. the relative contributions of particular components to total use of energy in SIC 33.
3. usual and conventional ideas of what is included in a particular industry.
4. common processing techniques.

The 13 components are as follows: 1. SIC 3312, 3315, 3316, 3317, consisting of companies engaged in the production of iron and steel and the manufacture of steel wire, strip, pipe, and tubes. The analysis concentrated on blast furnaces, coke ovens, steel works, and rolling mills which represent the basic iron and steel industry. Data produced by 89.5 percent of the steel industry was examined for purposes of setting targets.

2. SIC 3334, 3353, 3354, 3355, consisting of companies which refine alumina from bauxite and reduce the alumina to aluminum metal and fabrication plants. Data which represented 95 percent of the energy used in the aluminum industry was examined for purposes of setting targets.

3. SIC 3321 and 3322, including companies that cast gray iron, ductile iron, white iron, and malleable iron, but not including similar processes which are included in other SIC groups.

4. SIC 3331 and 3351, including companies which prepare blister and anode copper from concentrates, refine the metal into ingots and fabricate the ingots into such shapes as plate, sheet, extrusions, and bar.

5. SIC 3313, including plants engaged in the manufacture of additive alloys primarily for sale to the basic steel industry.

6. SIC 3361, 3362, and 3369, consisting of companies that manufacture aluminum, copper, magnesium, nickel, titanium, and zinc alloy castings.

7. SIC 3324 and 3325, including companies engaged in manufacturing steel castings.

8. SIC 3339, consisting of companies engaged in smelting and refining nonferrous metals other than copper, lead, zinc, and aluminum.

9. SIC 3356 and 3357, consisting of rolling, drawing, and extruding of nonferrous metals other than copper and aluminum as well as drawing and insulating of nonferrous metal wire and cable from purchased wire bars, rods, or wire.

10. SIC 3398 and 3399, consisting of companies engaged in heat treating of metals and the manufacture of metal powders.

11. SIC 3341, consisting of plants which recover nonferrous metals and alloys from new and used scrap and dross, plants which recover precious metals and plants which produce tin.

12. SIC 3333, including companies which smelt zinc from the ore, and refine zinc by other processes.

13. SIC 3332, including plants which extract and refine lead from ore.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

A large number of potential energy conservation measures were considered. In order to assess the likelihood of a measure influencing energy conservation in the industry components of SIC 33, each measure was evaluated with regard to its acceptance on the basis of demonstrated technology and economic attractiveness including any applicable time restraints. The measure of energy efficiency used in the primary metal industries in Btu's per ton of production output.

A. *Technological feasibility.* The technological criteria used for screening potential conservation measures are as follows: 1. Has the technology been demonstrated in newly designed commercial plants?

2. Has the technology been demonstrated in commercial retrofit installations?

3. Can the technology be installed on a large enough scale to significantly affect the use of energy by January 1, 1980?

4. Is manufacturing capacity available to produce all the new equipment?

5. Will the technology be outmoded by January 1, 1980?

6. What is the effect of lost production on the national market?

7. Does the potential measure satisfy anticipated non-discretionary requirements?

B. *Economic practicability.* Each measure that satisfied the above criteria was then considered and evaluated using the following economic method.

For each potential measure the capital investment necessary to implement the measure was divided by the number of millions of Btu saved annually to obtain the dollar amount per million Btu's saved annually. Only when the cost per million was $10 or less was the measure determined to be economically practicable. The $10 cutoff is based on an after tax 10 percent weighted average cost of capital and an energy price of $2 per million Btu.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

Primary metals is a capital intensive industry ranking sixth highest in capital intensity among all 28 industrial classifications in the Fortune 500 ranking. Among the 10 most energy consumptive industries SIC 33 is exceeded only by the petroleum and coal products industry (SIC 29) and requires on the average about 60 percent more capital per employee than the other eight industries. The great need for capital poses a difficult capital formation constraint on this industry. The high priorities for capital spending in SIC 33 are:

1. To increase plant capacity;
2. To improve environmental controls; and
3. To switch to available fuels.

These demands for capital are likely to impede the availability of capital for energy efficiency improvements.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

This appendix will only discuss the major aspects of the assessment of potential energy conservation measures. A detailed treatment of all the potential energy conservation measures which were considered can be found in the target support documents which are available for examination at the locations and times specified in the body of this notice.

A. *Potential measures identified.* 1. *SIC 3312, 3315, 3316, 3317—steel plants.* Twenty-six specific types of potential conservation measures were evaluated for technological feasibility and economic practicability for steel plants. Twelve of these items are process measures and 14 apply to housekeeping. The 12 process measures are:

a. Increased pellet usage in blast furnaces.
b. Increased blast-furnace gas recovery.
c. New and modernized blast furnaces.
d. Dry quenching of coke.
e. Blast-furnace coal injection.
f. External desulfurization.
g. Recovery of BOF offgas.
h. Preheating scrap for BOF with oxygen-fuel burner.
i. Increased electric-furnace capacity.
j. Increased continuous casting.
k. Increased use of induction heating of steel slabs.
l. Improvements in soaking pit, reheat, annealing, and heat-treating facilities.

2. *SIC 3334, 3353, 3354, 3355—aluminum.* Nineteen specific types of potential conservation measures were evaluated for the aluminum component. Seven of these items are process measures and 12 apply to housekeeping. The seven process measures are:

a. Convert 66 percent of rotary kilns for calcining alumina to fluidized bed calciners.
b. Improve efficiency of Hall Process.
c. Complete 100 percent conversion to silicon rectifiers.
d. Decrease melting losses by 50 percent.
e. Improve fabrication yield.
f. Double the amount of old scrap recycled.
g. Install air dampers on holding furnaces.

3. *SIC 3321, 3322—iron foundries.* Twenty specific types of potential conservation measures were evaluated for the iron foundries component. Eight of these items are process measures and 12 apply to housekeeping. The eight process measures are:

a. Increase electric melting by additional 25 percent of total melting.
b. Install recuperative hot blast on additional 15 percent of cupola capacity.
c. Install divided blast on additional 40 percent of cupola capacity.
d. Install electronic energy-management systems in foundries making 20 percent of annual production.
e. Convert additional 50 percent of "hot" methods for molding and coremaking to "cold" methods.
f. Use insulating sleeves on 30 percent of risers.
g. Preheat charges with waste heat for 40 percent of electric furnaces.
h. Increase yield by 2 percent by methods in addition to above.

4. *SIC 3331, 3351—copper.* Six specific types of potential conservation measures in addition to housekeeping were evaluated for the copper component as follows:

a. Conversion of multiple-hearth to fluidized-bed roasting.
b. Installation of Noranda process smelter at Garfield, Utah.
c. Installation of Outokumpu flash smelter at Hidalgo, NM.
d. Substitution of fuel oil for natural gas in smelting.
e. Oxygen-enrichment of air in converters.
f. Conversion of reverberatory furnaces for cathode smelting to ASARCO shaft furnace.

5. *SIC 3313—ferroalloys.* Two specific types of potential conservation measures in addition to housekeeping were evaluated for this component as follows:

a. Increase use of larger submerged-arc furnaces with improved controls.
b. Convert some open-hooded furnaces to "sealed" mode of operation.

6. *SIC 3361, 3362, 3369—nonferrous foundries.* Three specific types of potential conservation measures in addition to housekeeping measures were evaluated for this component, as follows:

a. Bulk transport of molten metal.
b. Improvement of furnace efficiency.
c. Preheating of furnace charges.

7. *SIC 3324, 3325—steel foundries.* Five specific types of potential conservation measures in addition to housekeeping measures were evaluated for this component, as follows:

a. Install electronic energy-management systems in foundries making 20 percent of annual production.
b. Convert additional 40 percent of "hot" methods for molding and coremaking to "cold" methods.
c. Use insulating sleeves on 30 percent of risers.
d. Preheat charges with waste heat for 40 percent of electric furnaces.
e. Increase yield by 2 percent by methods in addition to above.

8. *SIC 3339, 3356, 3357, 3398, 3341, 3333, 3332.* These components account for only 4.2 percent of the energy use in the primary metal industries. Approximately one process measure was evaluated for each of these components in addition to housekeeping.

B. *Efforts to reduce consumption of petroleum products and natural gas.* Curtailments of natural gas are already a major factor in some geographic areas, and risks of curtailment have encouraged early investment in oil-fired capability in the primary metal industries. Some metals manufacturing companies have indicated that use of purchased gas could be ended by 1980 for them, and these companies are switching to electricity as well as oil. Only a small fraction of energy applications are being converted to coal in the primary metal industries. Converting to coal requires high capital cost for new equipment, results in lower thermal efficiency compared to oil and natural gas, and requires more capital for environmental control equipment due to the particulate and sulfur in the flue gas. Few conversions have been made to coal because there have been inadequate incentives to justify increased use of coal by the primary metal industries.

V. DRAFT TARGET DEFINITION

A. *Component Goals.* The detailed evaluation of the best available information resulted in the following gross energy efficiency improvement goals for each of the thirteen components of SIC 33:

	Component goals (percent)
SIC 3312, 15, 16, 17: Steel plants	13.5
SIC 3334, 53, 54, 55: Aluminum	13.8
SIC 3321, 22: Iron foundries	26.5
SIC 3331, 51: Copper	13.0
SIC 3313: Ferroalloys	8.9
SIC 3361,62,69: Nonferrous foundries	9.1
SIC 3324, 25: Steel foundries	18.9
SIC 3339: Other primary nonferrous	11.3
SIC 3356, 57: Nonferrous processing	4.7
SIC 3398, 99 Miscellaneous metal products	7.1
SIC 3341: Secondary nonferrous smelting and refining	15.4
SIC 3333: Primary zinc	10.4
SIC 3332: Primary lead	11.1

B. *Proposed Two-Digit Gross Target.* For each component the 1980 energy use at 1972 energy efficiency in units of trillions of Btu's is shown in column A of the following table. Similarly, for each component, the 1980 energy improvement based on the projected implementation of conservation measures in units of trillions of Btu's is shown in column D. The 1980 energy use for each component as shown in column C was determined by subtracting the savings in column D from the energy use in column A. Column B repeats the component goals. The two-digit gross target percentage for SIC 33 is determined below by subtracting the total in column C from the total in column A, dividing by the total in column A and multiplying by 100. The proposed two-digit gross target for SIC 33 is 14 percent.

Gross target development

	(A) 1980 energy use at 1972 energy efficiency (10^{12} Btu)	(B) Gross percent improvement by 1980 for each component	(C) 1980 energy use if gross target is achieved (10^{12} Btu)	(D) Energy improvement by 1980 for each component (10^{12} Btu)
Component:				
3312, 15, 16, 17	3,753	13.5	3,245	508
3334, 53, 54, 55	741	13.8	639	102
3321, 22	170	[illegible]	125	45
3331, 51	92	13.0	80	12
3313	90	[illegible]	82	8
3361, 62, 69	44	9.1	40	4
3324, 25	[illegible]	[illegible]	43	10
3339	[illegible]	11.3	55	7
3356, 57	43	4.7	41	2
3398, 99	42	7.1	39	3
3341	[illegible]	15.4	33	6
3333	[illegible]	10.4	26	3
3332	9	11.1	[illegible]	1
Total	5,167	(1)	4,456	

[1] Ty=gross energy improvement target

$$=\frac{A-C}{A}\times 100$$

$$Ty=\frac{5{,}167-4{,}456}{5{,}167}\times 100=13 \text{ pct, use } 14 \text{ pct}$$

C. *Special circumstances effect.* Special circumstances are conditions imposed on an industry which are beyond the control of that industry and result in the use of additional energy to manufacture the same products. Examples of special circumstances in SIC 33 are the energy required for pollution control and the processing difference between ore grade in 1972 and 1980.

D. *Proposed two-digit net target.* For each component in SIC 33 the additional energy required by special circumstances was determined in units of trillions of Btu and recorded in column C of the table below. The gross component goals were adjusted by adding the additional energy required by special circumstances to the estimated gross target energy consumption in column B of the table below to obtain the 1980 energy use in column D for calculating the net target. The net component goals are shown in column E. The two-digit net target percentage for SIC 33 is calculated by subtracting the total in column D from the total in column A, dividing by the total in column A, and multiplying by 100. The proposed two-digit net target for SIC 33 is 10 percent.

	(A) 1980 energy use at 1972 energy efficiency (10^{12} Btu)	(B) 1980 energy use if gross target is achieved (10^{12} Btu)	(C) Energy for special circumstanc (10^{12} Btu)es	(D) 1980 energy use if net target is achieved (10^{12} Btu)	(E) Net percent improvement by 1980 for each component
Component:					
3312, 15, 16, 17	3,753	3,245	168	3,413	9.1
3334, 53, 54, 55	741	639	7	646	[illegible]
3321, 22	170	125	11	136	[illegible]
3331, 51	92	80	[illegible]	102	9.8
3313	90	82	[illegible]	86	4.4
3361, 62, 69	44	40	1	41	[illegible]
3324, 25	53	43	2	45	15.1
3339	62	55	1	56	9.7
3356, 57	43	41	0	41	4.7
3398, 99	42	39	0	39	7.1
3341	39	33	0	33	15.4
3333	29	26	2	28	3.4
3332	9	8	0	8	11.1
Total	5,167			4,674	

Tn=net energy efficiency improvement target=$\frac{A-D}{A}\times 100$

$Tn=\frac{5167-4674}{5167}\times 100=9.5$ pct use 10 pct

VI. FINAL TARGET DEFINITION

A. *Comments and impact on proposed target.* Testimony given at the December 9, 1976, public hearing and timely written comments have been thoroughly reviewed. The comments raised 10 general issues, as described below, and were primarily confined to the steel, aluminum, iron foundries, or copper components.

1. *Time constraints.* Several organizations raised the issue of insufficient time being allowed to obtain data sufficiently accurate to derive a meaningful energy efficiency improvement target. The time allowed to set the targets was prescribed by Section 374 of the EPCA which also specified that the targets should be based on the best available information. It should be noted that section 374(d) provides a mechanism whereby the targets as established can subsequently be modified. Accordingly, no further delay is warranted.

2. *Definition of economic practicability.* Virtually all of the public testimony stressed the importance of properly defining economic practicability and applying this criteria on an individual company basis in order to properly determine when investments in energy conservation should be undertaken. FEA fully recognizes the individual financial character of the companies which make up each four-digit classification. Much deliberation was given to considerations of the availability and cost of capital in the primary metals industry, and a method was derived to assist in the assessment of the maximum practicable investment for metal producing companies. On the basis of these considerations, FEA believes that the methods used to asses economic practicability were reasonable for setting a target.

3. *Variable production rates.* The issue was raised that lower production rates for several of the primary metal industries in the years between 1972 and 1980 could lead to significant increases in unit energy consumption and could therefore prevent attainment of the desired energy efficiency improvement. This problem was considered in the target support document which acknowledged that, in a period of depressed production, a plant or industry component may indeed show an increased use of energy per unit of output. The target document also pointed out, however, that if energy conservation has been effective, this will be revealed when production returns to its higher level. Lacking information to the contrary, this study assumed that the production rates for 1980 would at least equal those for 1972. Accordingly, no changes in the target due to this matter are warranted.

4. *Importance of recycling scrap.* Several comments pointed out the need to obtain increased amounts of purchased outside scrap in order to attain the energy conservation potential of these SIC 33 components. The availability of increased amounts of scrap for implementing the energy conservation measure was recognized in the target support document, and the derived energy efficiency improvement target does, in fact, reflect this consideration.

5. *Importance of voluntary reporting programs.* All spokesmen who submitted testimony at the public hearings were represented by trade associations who are presently cooperating with agencies of the Federal Government in voluntarily reporting energy consumption. Comments from these spokesmen stressed their belief in the importance of these programs as a part of the national effort to conserve energy. An important observation was also made regarding the particular significance of voluntary programs for components other than steel and aluminum. Attainment of the SIC 33 target is critically dependent on the performances of the steel and aluminum components. Any failure on their part to achieve the target would significantly increase the necessary effort from the other components. Even though their results may not be numerically significant, they are significant relative to several other industries outside SIC 33 and, therefore, are of considerable importance to the national effort. FEA recognizes that the voluntary reporting programs now under way for some components of the primary metal industries are important in tracking progress toward the national goal of energy conservation.

6. *The need for incentives.* The issue was raised that achievement of the gross energy efficiency improvement target could be strongly influenced by future changes in government policies which might either adversely affect the capital spending plans of industry or offer new incentives. If future government policies adversely affect incentives or encourage additional capital investment, then attainment of the target might become either unreasonably difficult or too easily obtained, depending on the nature of the policy changes. Under these circumstances, the target might require re-examination as provided for by Section 374(d) of EPCA.

7. *Insufficient credits for conserving critical fuels.* Several comments were made relative to the conflict between reducing total

energy consumption and reducing the use of critical fuels by the substitution of coal. Present methods and systems for measuring and reporting energy conservation progress do not include any provisions for giving "credits" to those companies which rely primarily on coal-derived fuels (as, for example, the steel industry) or to those who could convert to coal as a fuel. This problem was recognized in the draft support document which charged fuel consumption at certain specified Btu values, regardless of the nature of the fuel or its scarcity. If, sometime between now and 1980, a new method for computing energy efficiency improvement targets is derived which incorporates such credits for conserving scarce fuels, then this may require re-examination of the target as provided for by Section 374(d) of the EPCA.

8. *Expectations compared with targets.* Some comments stated that the industrial expectation relative to energy conservation is lower than the target. These comments implied that a target should not call for greater conservation than an industry expects to achieve while conducting its normal business. The EPCA, however, specifies that the energy efficiency improvement target should represent the maximum feasible improvement in energy efficiency. Accordingly, it is expected that greater effort than that of normal business expectations will be required by industry to attain the target.

9. *Specific comments on energy efficiency improvement options.* A representative of the American Iron and Steel Institute (AISI) testified at the hearing that AISI had in 1974 derived a target of 8 percent for its component without consideration of special circumstances, and stated that its current view is that a target of 4.3 percent is reasonable while a target of 7.4 is possible. AISI indicated that these figures compare with a component goal of 13.5 percent for this component in the draft target documents. The most significant contention by the AISI were that the computation of conservation potential for the steel component (as detailed in Appendix N of the target support document) should be based on the tonnage of steel expected to be produced in 1980 instead of the tonnage produced in 1972. FEA believes that on the basis of the best available information, the energy conservation potential for the steel component, as derived and expressed in the target support documents, is as reasonable as the lower potential which AISI espouses. Accordingly, no change to the final target is necessary.

The Aluminum Association commented, concerning the aluminum component, that the approach used in developing programs that are technologically feasible and economically practical is reasonable and that the energy conservation projects outlined are acceptable.

Representatives of the American Mining Congress (AMC) took exception to the energy savings estimated in the copper component for housekeeping changes and at the two new smelters which are being installed at Hidalgo, N. Mexico, and Garfield, Utah. The AMC representatives admitted that housekeeping changes have cut back energy use by several percent since 1972 but stated that an additional 5 percent in further savings was not possible on the basis of technical and economic criteria. FEA recognized that the original total of estimated housekeeping savings may have been excessive due to incomplete knowledge of the economic factors involved, and, as a result of the comments has revised the estimated housekeeping energy savings from 8.46 to 3.46 percent.

The AMC comments on the two new smelters pointed out that, due to future uncertainties in constraints for environmental controls, neither of these smelters may achieve the operational efficiences estimated in the target support document. FEA rejects the implications that neither of these new smelters will be more efficient than the average smelter which was operational in 1972.

As shown in the table below, the net result of the amended values is to reduce the estimated energy savings for the copper component from 13 to 8 percent. This effectively increases the estimated 1980 gross target energy consumption for the copper component from 80×10^{12} Btu to 84.6×10^{12} Btu.

	Energy savings (percent)		
	Target support documents	AMC judgments	Amended values
Housekeeping changes	8.46		3.46
Flash smelter at Hidalgo, N. Mex.	2.51		2.51
Noranda smelter at Garfield, Utah	1.31		1.31
Other sources	.72	0.72	.72
Total	13.00	4 to 5	8.00

A spokesman for the American Foundrymen's Society commented that the "overall target of a reduction of 10 percent in energy consumed per ton of product, industry-wide, appears reasonable."

10. *Specific comments on special circumstances.* The support document used in deriving the proposed component goal for the copper component estimated that when special circumstances for environmental controls were considered, with regard to that component the 1980 energy consumption for that component would be 102×10^{12} Btu's. This represents an increase of 27.5 percent in energy consumption over the gross component goal for the copper component. This increase was based on an industry estimate which considered as special circumstances the effects of air-quality regulations. AMC, however, contended in its comments that the 27.5 percent figure as determined by FEA neglected the energy costs for more stringent water-quality regulations, productivity decreases due to OSHA regulations, and lower production rates and, therefore, should be revised upwards. AMC suggested, a more inclusive estimate of the energy impact of special circumstances would be a 40 to 50 percent increase. FEA recognizes that an increase over its original estimate is appropriate. Accordingly, FEA has revised the original 27.5 percent increase in energy consumption by the copper component due to special circumstances to the higher figure of 40 percent.

B. *Final target values.* The following table takes into account the revisions in the figures for the copper component and reveals the conservation picture for the entire SIC 33.

Component	10^{12} Btu in target year, 1980 energy		
	Used at 1972 energy efficiency 10^{12} Btu	Use if gross target is achieved 10^{12} Btu	Use if net target is achieved 10^{12} Btu
Copper	92	84.6	118.4
All others	5,075	4,376.0	4,572.0
Total SIC 33	5,167	4,460.6	4,690.4

As displayed in the above table, SIC 33 could lower its consumption of energy in the target year from $5,167 \times 10^{12}$ Btu's to $4,460.6 \times 10^{12}$ Btu's if the energy for special circumstances is not considered, representing a gross conservation of 14 percent in energy efficiency improvement. After an adjustment of the gross target for special circumstances, SIC 33 could lower its consumption of energy in the target year to $4,690.4 \times 10^{12}$ Btu. This would represent a net improvement in energy efficiency of 9 percent.

The following is the energy efficiency improvement target set by FEA for SIC 33:

	Percent
Gross target, based solely on technological feasibility and economic practicability	14
Offset, based on consideration of special circumstances	5
Net target, based on technological feasibility and economic practicability plus consideration of special circumstances	9

APPENDIX H. STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 34—FABRICATED METAL PRODUCTS

I. INDUSTRY DESCRIPTION AND ENERGY BASE

The fabricated metal products industry comprising Standard Industrial Classification (SIC) 34 consists of 36 four-digit product classifications. This industry includes establishments engaged in fabricating ferrous and nonferrous metal products such as metal cans, tinware, hand tools, cutlery, general hardware, nonelectric heating apparatus, fabricated structural metal products, metal forgings, metal stampings, ordnance, and a variety of metal and wire products not elsewhere classified (n.e.c.). The units of output for this industry are base boxes, tons, square meters, and dollar value of shipments.

As a result of both the lack of voluntary energy conservation programs within the fabricated metal products industry and the large number of products and companies covered by SIC 34, the 36 four-digit classifications were grouped into seven components in order to establish the industry target. Four-digit SIC classifications which showed the following similarities were grouped together:

1. They collect data using similar units of output.

2. They make a similar quantitative contribution to total energy use within the fabricated metal industry.

3. They use similar processing techniques.

4. They are commonly considered to be similar.

The following table provides information on total energy consumption for SIC 34 during the 1972 base year including a breakdown, where available, of energy consumption for each four-digit classification within the seven groups.

Industry	SIC code	1972 energy consumed (10^{12} Btu's)	Percent
Cans and barrels:			
Metal cans	3411	32.2	
Metal barrels, drums, and pails	3412	5.9	
Total		38.1	7.6
Hardware, cutlery, and tools:			
Cutlery	3421	3.5	
Hand and edge tools, n.e.c.	3423	12.0	
Hand saws and sawblades	3425	NA	
Hardware, n.e.c.	3429	21.6	
Total		37.1	7.4
Sanitary ware: Metal sanitary ware	3431	8.43	
Total		8.43	1.7

Industry	SIC code	1972 energy consumed (10^{12} Btu's)	Percent
Forgings:			
Iron and steel forgings	3462	NA	
Nonferrous forgings	3463	NA	
Total		71.0	14.2
Stampings:			
Automotive stampings	3465	37.60	
Crowns and closures	3466	2.22	
Metal stampings, n.e.c.	3469	20.40	
Total		60.2	12.0
Plating and coating:			
Plating and polishing	3471	24.5	
Metal coating and allied services	3479	14.37	
Total		38.87	7.8
General fabrication:			
Fabricated structural metal products	3441	NA	
Metal doors, sash and trim	3442	NA	
Fabricated platework	3443	NA	
Sheet metalwork	3444	NA	
Architectural metalwork	3446	NA	
Prefabricated metal buildings	3448	NA	
Miscellaneous metalwork	3449	NA	
Subtotal		89.5	
Small arms, ammunition	3482	NA	
Small arms	3484	NA	
Ordnance and accessories, n.e.c.	3489	NA	
Ammunition, except for small arms	3483	NA	
Subtotal		50.2	
Valves and pipe fittings	3494	31.0	
Plumbing fittings and brass goods	3432	NA	
Heating equipment, except electrical	3433	NA	
Subtotal		9.1	
Screw machine products	3451	NA	
Bolts, nuts, rivets, washers	3452	NA	
Subtotal		27.7	
Steel springs, except wire	3493	NA	
Wire springs	3495	NA	
Miscellaneous fabricated wire products	3496	NA	
Metal foil and leaf	3497	NA	
Fabricated pipe and fittings	3498	NA	
Fabricated metal products, n.e.c.	3499	NA	
Subtotal		38.9	
Total		246.4	49.1
Grand total		500.10	100.0

The energy sources for SIC 34 are shown below.

Form of energy	Energy consumed (10^{12} Btu)	Percent of total
Fuel oil	39.8	9
Natural gas	212.2	48
Coal, coke	4.4	1
Electricity	97.3	22
Other	88.4	20
Total	442.1	100

A description of the seven components by four-digit classifications is provided below.

1. SIC 3411, 3412, cans and barrels, consists of establishments engaged in the manufacture of metal cans (3411) and plants producing metal shipping barrels, drums, kegs, and pails (3412).

2. SIC 3421, 3423, 3425, 3429, hardware, cutlery, and tools covers the fabrication of scissors, shears, trimmers, nonelectric razors, and razor blades (3421), a range of hand, edge, and mechanics tools such as rasps, shovels, scrapers, and hoes (3423), hand saws, and saw blades for hand and power driven saws (3425), and a variety of products such as furniture, hardware, vacuum and insulated bottles, night latches, deadlocks, and motor vehicle hardware (3429).

3. SIC 3431, metal sanitary ware includes the manufacture of enameled iron, and pressed metal sanitary ware as well as other metal plumbing fixtures which are not enameled.

4. SIC 3462, 3463, forgings consists of the production of metal forgings and stampings on a job order basis for sale or interplant transfer (3462) and the manufacture of nonferrous forgings (3463).

5. SIC 3465, 3466, 3469, stamping covers the manufacture of automotive stampings such as body parts, hubs, and trim (3465), metal crowns and closures such as metal bottle and jar caps and tops (3466), and metal stamping of porcelain enameled products such as household appliance housings and parts, metal garbage cans, and cooking and kitchen utensils which are stamped and spun.

6. SIC 3471, 3479, plating and coating, consists of companies engaged in anodizing, electroplating, plating, mechanical finishing and chemical treating operations (3471), and companies engaged in painting, hot dipping, engraving, and techning (3479).

7. The general fabrication component consists of 22 four-digit classifications representing 8900 establishments as follows:

(a) SIC 3441, 3442, 3443, 3444, 3446, 3448, 3449 includes the manufacture of fabricated structural metal products (3441), metal doors, sash, and trim (3442), fabricated platework (3443), sheet metalwork (3444), architectural metalwork (3446), prefabricated portable metal buildings and parts (3448), and miscelaneous metalwork (3449).

(b) SIC 3482, 3484, 3489, 3483 covers the manufacture of small arms ammunition (3482), small arms (3484), ordnance and accessories, n.e.c. (3489), and ammunition, except for small arms (3483).

(c) SIC 3494, 3432, 3433 includes the manufacture of valves and pipe fittings (3494), plumbing and heating equipment (3432), and heating equipment except electrical, including warm air furnaces (3433).

(d) SIC 3451, 3452 covers the manufacture of screw machine products (3451), and bolts, nuts, rivets, and washers (3452).

(e) SIC 3493, 3495, 3496, 3497, 3498, 3499 includes the manufacture of steel springs, except wire (3493), wire springs (3495), miscellaneous fabricated wire products (3496), metal foil and leaf (3497), fabricated pipe and fittings (3498), and fabricated metal products, n.e.c. (3499).

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

A large number of potential energy conservation measures were considered. Each potential measure was evaluated first with regard to its acceptability on the basis of demonstrated technology and then as to its economic attractiveness.

A. *Technological feasibility.* The criteria used for screening potential measures as to technological feasibility were:

1. Has the technology been demonstrated in newly designed plants?

2. Has the technology been demonstrated in retrofit installations?

3. Is the technology still in development with no prospect for use before January 1, 1980?

4. Is the effectiveness of the measure limited by the size of the plant in which it is installed?

5. Does industry accept the measure as fully demonstrated?

6. Does the potential measure satisfy environmental requirements?

7. What special materials and manpower resources are required?

The measures which passed the initial screening were then tested to conform to the following time constraints:

1. Is the total lead time required for installation and operation excessive?

2. Is extensive shut-down time required of the existing plants for retrofit installation or tie-in?

3. Is the measure consistent with plans of the industry to conserve energy?

4. Is the measure consistent with the possibility of curtailment of natural gas?

B. *Economic practicability.* Each measure that passed the technological screening was then evaluated by the following economic rating system.

1. Type of investment needed: Low investment, short payback period short lead time, score 5; intermediate, score 3; major capital investment, long payback period, score 1.

2. Degree of implementation by industry: Widely utilized by industry, score 5; intermediate, score 3; very limited utilization by industry, score 1.

3. Maturity of technology: Old technology, economics well known, score 2; new technology, economics of which are relatively unknown, score 1.

The results of the ratings are summarized in the following table.

Economic practicability rating sheet

Energy saving investment	Type of investment needed (score 1 to 5)	Degree of implementation by industry (score 1 to 5)	Maturity of technology (score 1 to 2)	Economic practicability score
Housekeeping, lighting	5	3	2	10.
Scheduling changes	5	2 to 3	2	9 to 10.
Housekeeping, insulation	4	3	2	9.
Improved furnace efficiency	4	3	2	9.
Reduced utility potentials	5	2	2	8.
Insulating against process heat losses	4	3	2	9.
Utilize scrap fluids as fuel	5	2	2	9.
Low solvent coatings	4	3	2	9.
Housekeeping, heating/cooling	4	2 to 3	2	8 to 9.
Reduced hot working temperature	5	1	2	8.
Changes in Materials-process specifications	3 to 4	1	2	6 to 7.
Electroless plating	4	1	1	5.
Waste heat recuperation/Hot to cold forging	2/2	1 to 2/1	2/2	5 to 6/6.
Housekeeping, computer control system	1	1	2	4.
Improved electric motor efficiency	1	1	2	4.
Higher efficiency forging furnaces	1	1	2	4.
Ultraviolet and pin ovens for can manufacture.	1	1	2	4.
Furnace conversion, gas to electric	1	1	1 to 2	3 to 4.
New coil painting technology	1	1	1	3.
New chromium plating technology	1	1	1	3.

Those measures having ratings of 6 or above are economically practicable and their implementation into SIC 34 industries can and will improve energy efficiency by the target date of January 1, 1980. Those items ranking 3 to 5 will likely be implemented in some companies in SIC 34 and can contribute to their achievement of the ultimate target but could not be sufficiently implemented on an industry-wide basis to be considered in establishing the SIC 34 target. Items which scored below three were not considered economically practicable.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

SIC 34 incorporates a great number (30,000) of companies which produce a large variety (1,000) products. Thirteen thousand companies in this industry are job shop type operations which employ less than 20 people. In the larger establishments, energy costs generally account for one percent of the dollar value of the end product and are not high enough to justify the investment unless conventional energy sources are curtailed. If more capital was available in this industry for retrofitting and building new plants, the maximum feasible energy improvement would be considerably higher. The energy efficiency improvement measures which were evaluated generally require a relatively small monetary investment and provide a short payback period.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

The target support documents, copies of which are available for inspection as provided for in the body of this notice, contain a detailed treatment of the consideration of potential energy conservation measures. This appendix will only discuss the major aspects.

A. *Potential measures identified.* The following suggestions represent the type of measures that were finally identified as technologically feasible and economically practicable:

1. Turn ovens and furnaces to low fire when on standby.
2. Turn off equipment when not in use.
3. Install combustion monitoring and control of ovens, furnaces, boilers.
4. Install high efficiency ovens, furnaces, boilers.
5. Use wateborne solvent systems to eliminate need for afterburners on coating ovens.
6. Install heat recuperators to recover waste heat.
7. Install catalysts in afterburners to reduce energy consumption.
8. Install process changes that would result in an overall 25 percent decrease in energy use.
9. Install combustion control on melting furnaces including monitoring, recuperation, and insulation.
10. Use single coating to eliminate double firing in porcelainizing.
11. Use coatings that do not require firing.
12. Use lower process temperatures.
13. Improve air seals and circulatory systems.
14. Improve insulation.
15. Switch from gas to electric heating.
16. Preheat make-up air.
17. Recover waste heat.
18. Use cold wash processes.
19. Improve process controls and scheduling.
20. Reduce heat loss from baths with floating spheres.

B. *Efforts to reduce consumption of petroleum products and natural gas.* As a result of natural gas shortages, many companies have converted from natural gas to fuel oil for heating. Some conversion to electric heating is occurring particularly in certain segments of the forging industry where high volume and fixed product size permits the use of electric heating. The trend over the next few years will be to equip gas-fired furnaces with dual controls to accommodate oil. On a limited scale, induction heating and resistance heating will replace gas-fired furnaces. This industry has few plans to convert to coal due to the lack of technology for greater than 50 percent of the establishments.

V. PROPOSED TARGET DEFINITION

A. *Component goals.* The detailed evaluation of the best available information resulted in the following gross energy efficiency improvement goals for each of the seven component groups of SIC 34 which were analyzed.

	Component goals
1. SIC 3411, 12: Cans and barrels	24.7
2. SIC 3421, 23, 25, 29: Hardware, cutlery, and tools	29.7
3. SIC 3431: Sanitary ware	19.0
4. SIC 3462, 63: Forgings	30.1
5. SIC 3465, 66, 69: Stampings	31.6
6. SIC 3471, 79: Plating and coating	19.6
7. SIC 3441, 42, 43, 44, 46, 48, 49, 82, 84, 89, 83, 94, 32, 33, 51, 52, 93, 95, 96, 97, 98, 99: General fabrication	22.6

B. *Proposed two-digit gross target.* For each component, the 1980 energy use at 1972 energy efficiency in units of trillions of Btu's is shown in column A of the following table. Similarly, for each component, the 1980 energy improvement based on the projected implementation of conservation measures in units of trillions of Btu's is shown in column D. The 1980 energy use for each component as shown in column C was determined by subtracting the savings in column D from the energy use in column A. The component goals are repeated in column B. The two-digit gross target for SIC 34 was determined by subtracting the total in column C from the total in column A, dividing by the total in column A and multiplying by 100. The gross component goals were determined by performing the same evaluation for each component. The proposed two-digit gross target for SIC 34 is 25 percent.

Gross target development

Component	(A) 1980 energy use at 1972 energy efficiency (10^{12} Btu)	(B) Gross percent improvement by 1980 for each component	(C) 1980 energy use if gross target is achieved (10^{12} Btu)	(D) Energy improvement by 1980 for each component (10^{12} Btu)
Cans and barrels	45.37	24.7	34.17	11.20
Hardware, cutlery, and tools	50.90	29.7	35.80	15.10
Sanitary ware	12.11	19.0	9.81	2.30
Forgings	93.60	30.1	65.40	28.2
Stampings	47.20	31.6	32.30	14.9
Plating and coating	38.87	19.6	31.25	7.62
General fabrication	298.90	22.6	231.20	67.7
Total	586.95	(1)	440.0	

[1] Tg = gross energy improvement target $= \frac{A-C}{A} \times 100$.

$Tg = \frac{586.95 \text{ to } 440.0}{586.95} \times 100 = 25.0$ pct.

C. *Special circumstances effect.* Special circumstances are conditions imposed on an industry which are beyond the control of that industry and result in the use of additiona lenergy to manufacture the same products. ffnergy required for pollution control was the only special circumstance identified for SIC 34.

D. *Proposed two-digit net target.* For each component in SIC 34 the additional energy required by special circumstances was determined and recorded in column C in the table below. The gross component goals were adjusted by adding the additional energy required by special circumstances to the estimated gross target energy consumption in column B of the table below to obtain the 1980 energy use in column D for calculating the net target. The net component goals are shown in column E. The two-digit net target percentage for SIC 34 is calculated by subtracting the total in column D from the total in column A, dividing by the total in column A, and multiplying by 100. The proposed two-digit net target for SIC 34 is 24 percent.

Component group	A 1980 energy use at 1972, energy efficiency 10^{12} Btu's	B 1980 energy use if gross target is achieved 10^{12} Btu's	C Energy for special circumstances 10^{12} Btu's	D 1980 energy use if net target is achieved 10^{12} Btu's	E Net percent improvement by 1980 for each component
Cans and barrels	45.37	34.17	3.99	[illegible]	15.9
Hardware, cutlery, and tools	50.90	35.80	0	35.80	29.7
Sanitary ware	12.11	9.81	.03	9.84	18.7
Forgings	93.60	[illegible]	0	65.40	30.1
Stampings	47.20	[illegible]	0	[illegible]	31.6
Plating and coating	38.87	31.25	1.45	[illegible]	15.9
General fabrication	[illegible]	231.20	0	231.2	[illegible]
Total	586.95			445.4	

Tn = net energy efficiency improvement target $= \frac{A \text{ to } D}{A} \times 100$.

$Tn = \frac{[\text{illegible}] \text{ to } 445.40}{586.95} \times 100 = 24.1$ pct., use 24.0 pct.

VI. FINAL TARGET DEFINITION

A. *Comments and impact on draft target.* Testimony given at the November 30, 1976, public hearing and timely written comments have been thoroughly reviewed. The comments generally were addressed to four general issues.

1. *Form and availability of data.* The quality of the data used in formulating the SIC 34 target and aggregation of less than optimum information into an industry wide target was the subject of comment by those companies and trade associations which have atttempted to develop their own meaningful energy consumption and conservation data. FEA recognizes that the quality of the data available was not perfect, but FEA was required by EPCA 374(a) to set the target based on the best information available. Energy efficiency improvements will vary from company to company within SIC 34, depending upon the types of processes being used, the products being produced, and the age of the plant and equipment. The final target represents a goal in energy conservation for the entire SIC 34 industry and is not necessarily applicable to any one company or establishment.

2. *Definition of Btu's per unit of output.* FEA recognizes as several comments indicated that Btu's per unit of output may not be a meaningful definition of energy usage for all industries. While efforts have been made by many companies and trade associations to determine a meaningful unit which will accommodate variations in production, process changes, and capacity utilization, FEA believes no appropriate measure has been developed which would justify any changes in the target. In most instances, data on energy consumption per unit was not available. Various units of output used included the dollar value of shipments for four of the seven components, and various physical units for the others such as baseboxes of cans, tons of forgings, and square meters of plating and coating.

3. *Effects of new plant construction.* It was pointed out in the hearing that consideration must be given to companies which already have plans for constructing new plants using energy efficient technologies in the 1972-80 time period. These plants obviously cannot achieve an additional 24 percent improvement in energy efficiency. Since the energy efficiency target for the SIC 34 industry is not meant to be applied to any single plant, this comment cannot effect the calculation of the final target value.

4. *Tax incentives.* Some statements were made during the hearing that energy conservation and the use of energy-efficient processes would be more quickly implemented if tax incentives and reduced interest loans were made available to American industry. FEA has acknowledged the importance of economic incentives in the target support document under the evaluation of economic practicability.

B. *Final target values.* None of the comments submitted to FEA required any adjustment of either the proposed gross or net targets. FEA has determined that SIC 34 could lower its consumption of energy in the target year from 586.95×10^{12} But's to 440×10^{12} But's if the energy for special circumstances is not considered, representing a gross conservation of 25 percent in energy efficiency improvement. After an adjustment of the gross target for special circumstances, SIC 34 could lower its consumption of energy in the target year to 445.4×10^{12} Btu. This would represent a net improvement in energy efficiency of 24 percent.

The following is the energy efficiency improvement target set by FEA for SIC 34:

	Percent
Gross target, based solely on technological feasibility and economic practicability	25
Offset, based on consideration of special circumstances	1
Net target, based on technological feasibility and economic practicability plus consideration of special circumstances	24

APPENDIX I: STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 35—MACHINERY, EXCEPT ELECTRICAL*

I. INDUSTRY DESCRIPTION AND ENERGY BASE

Standard Industrial Classification (SIC) 35 divides the machinery industry into 45 four-digit product classification which are further grouped into nine three-digit classifications. Components are defined by three-digit product classification in the table below. The 1972 energy consumption of the three-digit classifications is as follows:

SIC	Industry	1972 energy consumed 10^{12} Btu	Percent
351	Engines and turbines	30.0	6.9
352	Farm and garden machinery and equipment	49.4	11.3
353	Construction, mining, and materials handling machinery and equipment	75.1	17.2
354	Metalworking machinery and equipment	57.2	13.1
355	Special industry machinery, except metalworking machinery	39.6	9.1
356	General industrial machinery and equipment	63.5	14.5
357	Office, computing, and accounting machines	25.5	5.8
358	Refrigeration and service industry machinery	59.7	13.6
359	Miscellaneous machinery, except electrical	37.4	8.5

Energy sources for SIC 35 in 1972 were:

Form of energy	10^{12} Btu	Percent of total
Coal	36.7	8.4
Natural gas	183.5	41.9
Fuel oil	41.4	9.5
Electricity	90.6	20.7
Other	85.2	19.5
Total	437.4	100

The three-digit industry components are defined as follows: 1. Engines and Turbines, SIC 351, comprises the manufacture of turbines (except aircraft), turbine generator set units, steam engines, and diesel, semi-diesel, or other internal combustion engines not elsewhere classified.

2. Farm and garden machinery and equipment, SIC 352, comprises the manufacture of tractors and other farm equipment, and snowblowers, lawn mowers and other lawn and garden equipment.

3. Construction, mining, and materials comprises the manufacture of heavy conhandling machinery and equipment, SIC 353, struction equipment (bulldozers, concrete mixers, pavers, power shovels), heavy mining equipment (coal cutters, rock drills and crushers, mine cars), oil and gas fired field equipment (derricks, drill rigs and drill tools), elevators and moving stairways, conveyors, hoists, cranes, monorail systems, and industrial trucks, tractors, trailers and stackers for use in and around industrial facilities.

4. Metalworking machinery and equipment, SIC 354, comprises the manufacture of metal cutting and metal forming machine tools, special dies and tools, machine tool accessories and measuring devices, power driven hand tools, rolling mill machinery and other metalworking machinery not elsewhere classified.

5. Special industry machinery, SIC 355, comprises the manufacture of machinery for use by other major industries including food, textiles, paper, chemicals, and petroleum.

6. General industrial machinery, SIC 356, comprises the manufacture of pumps, ball and roller bearings, air and gas compressors, blowers and exhaust and ventilation fans, industrial process furnaces and ovens, power transmission equipment, and other general industrial equipment.

7. Office, computing and accounting machines, SIC 357, comprises the manufacture of typewriters, electronic computing equipment, calculating and accounting machines, scales and balances (except laboratory), and other general office equipment.

8. Refrigeration and Service industry machinery, SIC 358, comprises the manufacture of automatic merchandising machines, commercial laundry, dry cleaning, and pressing machines, air conditioning and warm air heating equipment, commercial and industrial refrigeration equipment, measuring and dispensing pumps, and other service industry machines not elsewhere classified.

9. Miscellaneous machinery, except electrical, SIC 359, comprises the manufacture of carburetors, pistons, piston rings, valves, amusement park equipment, pneumatic and hydraulic cylinders, flexible metal hose and tubing, and other miscellaneous machinery.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

To determine the maximum feasible energy efficiency improvement achievable by 1980, potential energy conservation measures were assessed for both technological feasibility and economic practicability.

A. *Technological feasibility.* The potential energy conservation measures which were considered may be classified into five categories.

1. Improvements or modification to equipment.
2. Changes in processes.
3. Conversions to electric power.
4. Improvements in operating practice.
5. Housekeeping improvements in buildings and services.

A potential energy conservation measure was considered to be technologically feasible only if it satisfied all the following criteria:

1. Any technology involved had to have been demonstrated preferably in an operating plant or at least in a pilot plant.
2. Any equipment to be purchased or modifications to be made, could be in operation by January 1, 1980.
3. Any modifications of equipment had to have direct application to industries involved in this study.
4. Any process change had to be technologically acceptable to the industry affected.
5. Process changes could be in operation by January 1, 1980.
6. Conversion to more available forms of energy had to be based on technology which was developed and available.
7. Changes from fuel fired to electrically heated equipment had to be based on availability of the equipment for installation by 1980.

*Target development for SIC 35, 37 was treated identically because of the similarity of the two industries.

8. Conversion to electrically heated equipment had to be based on the availability of sufficient amounts of electric power by January 1, 1980.

Technological feasibility was further constrained by secondary factors associated with the industry. Conversions to electrically powered melting and heating equipment were limited to a percentage of existing installations because delivery times for most electric induction and power distribution equipment are now more than two years. In addition, because most foundry, forge shop and heat treating shop capacity is in the Midwest, a serious impact on electric power availability would occur with complete conversion to electricity within the next two or three years. Despite the long-range potential for energy conservation by use of more efficient electric motors, FEA has concluded it would be impossible to change any large percentage of existing motors within the next few years, even if sufficient quantities were available by 1980.

Serious consideration was given to the potential for improving fuel fired heating furnace efficiency by adding insulation to the outside walls and by substituting lightweight refractories for conventional refractories. Some potential energy savings were calculated on a limited application of insulation and refractory changes. Because all furnaces have structural steel frameworks and the majority have a plate or sheet shell for enclosing and sealing the refractory construction, insulation cannot simply be added to the outside of the steelwork. In most cases it would be necessary to rebuild the furnaces completely to add insulation or to install lightweight refractories. While this will be done in some instances in the next few years, it would not be possible for all furnaces to be rebuilt by 1980.

Three estimates of 1980 energy consumption based on technologically feasible measures were made: (a) The first estimate involved implementing only those conservation measures which required capital investment for new equipment or alterations to existing equipment.

(b) The second estimate involved implementing only improved operating practices.

(c) The third estimate was the result to be achieved through implementing the conservation measures in (a) and (b).

B. *Economic practicability.* Only those potential conservation measures which required new or altered equipment as described in (a) above were analyzed for economic practicality. They accounted for 4.2 percent of the total 18.7 percent technologically feasible efficiency improvement. Conservation measures which required improved operating processes were not analyzed for economic practicality because their implementation can be achieved with minimal expense. The economic screening was based on the following factors:

1. Industry growth rates.
2. Energy cost projections.
3. General inflation projections.
4. Industry composite cost of capital.
5. Return on investment.
6. Capital availability.
7. Other factors, including utilization, age, location, and energy dependability.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

A. *Required return on investment.* Seventeen energy conservation measures were found to be economically practicable for one or more of the three-digit component industries. These measures are presented below with related capital investment and energy savings.

1980 energy savings per total investment dollar period 1976 to 1979

Conservation measure	Total program investment (dollars in millions)	1980 energy savings (billion Btu)
Painting, drying catalytic incinerator	1,741.34	1,060.15
Ferrous foundry, Grey iron heat recovery process	1,088.26	913.26
Nonferrous foundry, brass melting	113.14	88.06
Painting, drying airless paint	4,358.28	3,120.23
Forging, fuel fired conversion	2,589.40	1,118.94
Nonferrous die casting, fuel fired conversion	1,148.37	414.13
Nonferrous foundry, aluminum melt	1,002.27	306.57
Nonferrous foundry, aluminum core making	160.38	48.89
Nonferrous foundry, brass casting	17.80	5.43
Ferrous foundry, malleable iron to electric conversion	10,591.66	2,327.05
Forging, electric conversion	10,432.44	1,861.81
Ferrous foundry, Grey iron to electric conversion	10,898.42	2,436.21
Powder metallurgy conversions	3,856.48	472.58
Painting, drying insulation	17,413.19	2,120.23
Heat treating, direct fired recoup	717.86	64.97
Heat treating, steel heat treat	9,266.05	717.23
Painting, baking insulation	13,230.53	903.40
Total	98,164.86	16,648.17

The hurdle rates in effect in SIC 35 as developed from industry interviews and converted from the payback periods in which they were used varied over the industry from a low of 20 percent to a high of 41.5 percent.

B. *Capital spending priorities.* Although a particular energy conservation measure may be both technologically and economically feasible, constraints may exist in a company which would foreclose implementation of the measure. Among these additional considerations are:

1. Capital availability in the industry.
2. Plant utilization rates.
3. Geographic locations.
4. Lack of dependable energy supply source.
5. Likely curtailment of natural gas supply.
6. Collective bargaining agreements preventing process modification.
7. Adverse effects on employee morale or company image.
8. State and local government fiscal integrity.
9. Employment.
10. Regional economic activity.
11. Prices.
12. Low and middle income families.
13. Small business.
14. Sectoral completion.

Implementation of all economically feasible conservation programs for SIC 35 would require $98.2 million in expenditures between 1976 and 1980. The machinery industry spent $4.43 billion in 1974 on expansion, replacement and modernization of equipment and facilities. In 1975, the industry planned to spend $4.46 billion. Projected expenditures for 1976, 1977 and 1978 are $4.90 billion, $5.18 billion and $5.28 billion respectively. As the following table shows, an annual expenditure of $24.55 million for conservation measures would require only a small share of total capital allocated for expenditures and would pose no restraint on implementation of the measures.

Conservation program costs (in millions of dollars)

SIC	Industry	Annual conservation program expenditures (4 year average)	1974 capital expenditures excess of manufactures	Percent
351	Turbines and engines	0.99	188.1	0.5
352	Farm machinery	4.14	163.4	2.5
353	Construction machinery	5.18	275.4	1.9
354	Metalworking machinery	2.35	218.7	1.0
355	Special machinery	2.58	184.2	1.4
356	General machinery	5.08	229.7	2.4
357	Office machinery	.76	286.6	.3
358	Service machinery	1.03	228.3	.5
359	Other, n.e.c	1.36	149.1	.9
	Total	24.54	1,903.5	1.3

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

A detailed treatment of all the potential energy conservation measures which were considered can be found in the target support documents which are available for examination at the locations and times as indicated in the body of this notice. Only the major aspects are treated here.

A. *Potential measures identified.* All component industries in SIC 35 use the same basic processes for metalworking and metalfinishing. Since these processes require large amounts of energy, many potential conservation measures were aimed at these basic processes. Those measures which require significant capital expenditures and which contributed significantly to the target for SIC 35 are shown according to the associated industrial process:

1. Ferrous foundry: waste heat recuperation, electric melting.

2. Nonferrous foundry: improved charging system, waste heat recuperation, combustion control equipment, infrared heating, furnace insulation.

3. Die casting: waste heat recuperation, insulation, combustion control equipment, covers on charging wells.

4. Forging: waste heat recuperation, furnace insulation, combustion control equipment, electric heating.

5. Heat treating: waste heat recuperation.

6. Painting and coating: airless drying, catalytic incineration, insulation.

7. Powder metallurgy: waste heat recuperation, recycle atmosphere gas, furnace insulation.

The following measures were considered but eliminated by the screening process described below:

1. Nonferrous foundry: electric melting.

2. Die casting: electric melting.

3. Heat treating: cascade heat recovery, electric heating.

4. Galvanizing: conversion to electric, waste heat recuperation.

5. Painting and coating: waste heat recuperation, combustion control equipment, electric drying.

No conservation measures involving capital expenditures were identified for the following processes: electroplating, structural

and plate fabrication, stamping, blanking, forming, assembly.

Modifications in operating procedures which require insignificant capital investments are:

TYPE OF EQUIPMENT AND NATURE OF IMPROVEMENT

1. Cupola furnace: Use of optimum iron-coke ratio control; careful coke handling to reduce breakage; tuyere maintenance to reduce air losses; repair leaks in blast air piping; maintain insulation on hot blast system; and tap iron at minimum allowable temperature.

2. Electric arc furnace: Maintain refractories to minimize heat loss; maintain roof and doors to minimize heat loss; control rate of feed of electrodes; and control of furnace cycles to avoid peak loads.

3. Heating furnace: Maintain refractories and insulation; seal up openings in walls and roof; keep doors closed to minimize heat loss; adjust fuel-air ratio to optimum setting; shut down when not in use; and remove unused material from car bottoms.

4. Mechanical equipment: Good maintenance and lubrication; shut down when not in use; keep curring tools and dies sharp; drain chips and reuse cutting oils; and repair leaks in hydraulic systems.

5. Welding and brazing: Repair leaks in gas and oxygen lines; shut off torches when not in use; and maintain welding tips in good condition.

6. Washing: Use lower temperature water; combine or eliminate washing operations; and recirculate washer and rinse waters.

Additional conservation could be achieved with a minimum of capital expenditures by implementing routine housekeeping and maintenance on buildings and services. Some 25 to 50 percent of total energy consumed is expended for building heating, ventilating, air conditioning, lighting, and for other miscellaneous plant services.

A partial tabulation of these many potential improvements is provided.

AREA AND NATURE OF IMPROVEMENT

1. Buildings: Close building openings; Repair broken walls, windows; insulate walls and roofs; isolate space not used for products; and install translucent panels to reduce lighting requirements.

2. Heating, ventilating, air conditioning: Reduce temperatures of heating; increase temperature of cooling; reduce air changes per hour; recirculate air where possible; heating with waste process heat; reduce heating to minimum in nonworking areas; and close all unnecessary openings.

3. Lighting: Reduce lighting levels to minimum; turn lights out in nonworking areas; use more efficient lighting systems; and use timers to control lighting.

4. Boiler houses: Convert to coal heating; maintenance improvement on boilers; combustion control on boilers; use plant wastes for heating; and install air preheaters using waste heat.

5. Piping systems: Repair leaks in pipelines; turn off air and water nozzles; and install insulation on steam lines.

6. Electrical systems: Install efficient wiring; use power factor correction; and reduce motor sizes where possible.

B. EFFORTS TO REDUCE CONSUMPTION OF PETROLEUM PRODUCTS AND NATURAL GAS

The principal area for substituting more available energy forms for scarce energy forms are conversion of oil or gas fired boilers to coal fired boilers and replacement of fuel fired melting and heating furnaces with electric furnaces. With few exceptions, the substitution of coal or electric power for oil or gas involves replacement of equipment and this capital cost consideration has minimized conversions. Where gas or oil are not available, or where pollution control or obsolescence dictate the change, conversions have often been made, but they rarely offer a substantial return on investment where energy costs are the only consideration.

V. PROPOSED TARGET DEFINITION

A. *Component goals.* A detailed evaluation of the technologically feasible and economically practicable conservation measures resulted in the following gross energy efficiency improvement goals for each three-digit classifications in SIC 35.

	Component goals (percent)
SIC 351: Engines and turbines	15.5
SIC 352: Farm and garden machinery and equipment	18.5
SIC 353: Construction, mining, and materials handling machinery and equipment	17.5
SIC 354: Metalworking machinery and equipment	17.3
SIC 355: Special industry machinery, except metalworking machinery	17.3
SIC 356: General industrial machinery and equipment	16.0
SIC 357: Office computing and accounting machines	16.7
SIC 358: Refrigeration and service industry machinery	15.2
SIC 359: Miscellaneous machinery, except electrical	17.0

B. *Proposed two-digit gross target.* In the following table, 1980 energy use at 1972 energy efficiency is recorded for each three-digit classification in column A. Similarly, for each component, 1980 energy saving from implementing conservation measures is recorded in column B. 1980 energy consumption for each component, recorded in column C, was determined by substracting the savings in column D from the energy use in column A. Column B repeats the component goals. The two-digit gross target percentage for SIC 35 is determined below by subtracting the total in column C from the total in column A, dividing by the total in column A and multiplying by 100.

	(A) 1980 energy use at 1972 energy efficiency (10^{12} Btu)	(B) Percent improvement by 1980 for each component	(C) 1980 energy use if gross is achieved (10^{12} Btu)	(D) Energy improvement by 1980 for each component (10^{12} Btu)
Component:				
351	53.504	15.5	45.209	8.295
352	77.848	18.5	63.459	14.389
353	118.863	17.5	98.004	20.859
354	99.974	17.3	82.707	17.267
355	61.657	17.3	50.979	10.678
356	102.520	16.0	86.075	16.445
357	40.180	16.7	33.488	6.692
358	93.971	15.2	79.697	14.274
359	58.805	17.0	48.791	10.014
Total	707.322	(1)	588.409	

[1] Ty=gross energy improvement target=$\frac{A-C}{A}\times 100$

$Ty=\frac{707.322-588.409}{707.322}\times 100=16.8$ pct, use 17 pct.

C. *Special circumstances effect.* Special circumstances are conditions beyond the control of the industry which require additional energy consumption. Examples of special circumstances in SIC 35 are pollution control and occupational safety and health regulations.

D. *Proposed two-digit net target.* For each component in SIC 35 the additional energy required by special circumstances is recorded in column C in the following table. 1980 energy consumption for each three-digit classification was adjusted by adding this additional energy requirement to the figure in column B. The two-digit net target percentage for SIC 35 is calculated below by subtracting the total in column D from the total in column A, dividing by the total in column A, and multiplying by 100.

	(A) 1980 energy use at 1972 energy efficiency (10^{12} Btu)	(B) 1980 energy use if gross target is achieved (10^{12} Btu)	(C) Energy for special circumstances (10^{12} Btu)	(D) 1980 energy use if net target achieved (10^{12} Btu)	(E) Percent improvement if net target is achieved
Component:					
351	53.504	45.209	1.170	46.379	13.3
352	77.848	63.459	1.349	64.808	16.8
353	118.863	98.004	2.807	100.811	15.2
354	99.974	82.707	1.861	84.568	15.4
355	61.657	50.979	1.032	52.011	15.6
356	102.520	86.075	1.714	87.789	14.4
357	40.180	33.488	.693	34.180	14.9
358	93.971	79.697	1.880	81.577	13.2
359	58.805	48.791	1.118	49.909	15.1
Total	707.322	(1)		601.222	

[1] T_n=net energy efficiency improvement target=$\frac{A-D}{A}\times 100$

$T_n=\frac{707.322-601.222}{707.322}\times 100=15$ pct

VI. FINAL TARGET DEFINITION

A. *Comments and impact on draft target.* No testimony was presented during the public hearing scheduled for November 22 and 23, 1976, but written comments from five corporations were subsequently received. The comments were sufficiently diverse so that classification on the basis of issues was impractical. Consequently, each of the comments are treated here individually.

One comment stated that the proposed 15 percent energy efficiency target for SIC 35 is excessive and dependent on numerous uncertain factors. The comment, however, provided no information to support this contention. The proposed target is a weighted computation based on component goals derived from each component's energy consumption. The SIC 35 component goals were all sufficiently close to the proposed two digit gross target so that any corporation in any one of the components should be able to meet the composite two-digit target if it could realize the level of conservation developed for the component. On a plant-by-plant or company-by-company basis, conservation measures may have a different impact. However, FEA believes that the treatment of available data justifies the development of the proposed two-digit target.

One comment indicated a major concern with the method and accuracy of measuring actual improvements in energy efficiency. FEA recognizes that a given unit of output measurement may not be acceptable to all activities in SIC 35 and that a single unit of output can not necessarily be used for all SIC 35 component activities. Various measurement bases coupled with several indices of efficiency, such as floor area, number of employees, and product units were examined in developing the target value. The output index used was the number of production workers because statistics relative to this index were the most comprehensive.

Several comments expressed concern that appropriate and high quality data are not available for the base year 1972. 1972 was selected by FEA as the base year because it was the last full calendar year before the embargo. FEA believes that the data for 1972 used in determining the proposed target was certainly adequate to justify the target value.

A number of comments were concerned with the availability of capital for investment in energy conservation technologies. FEA believes that since energy conservation projects must compete with all other projects for investment capital, the availability of investment capital will ultimately depend upon an acceptable rate of return for the investment. SIC 35 generally faces no difficulty in raising capital for projects which meet the return on investment (ROI) criteria. Potential conservation measures were judged against each component industry's ROI criteria. Capital availability should not inhibit implementation of the identified conservation measures.

One company suggested a further special circumstances adjustment for the effect of weather on the amount of energy used in a building environment and for conditioning the make-up air for manufacturing processes, based on its own experience. FEA believes that adjustments based on individual plant operating conditions and experience are not appropriate to target setting.

Several comments indicated that the use of a target at the two-digit level is misleading and unmanageable because the industry does not operate, measure or manage its activities on a two-digit industry-wide basis. Targets at the two-digit SIC level are required by the EPCA. The target document takes cognizance of individual companies by deriving the target from a three-digit analysis of the industry. Use of the three-digit level components closely approximate the character of the usual business operation for data gathering purposes and is consistent with reporting that is currently submitted to the Bureau of Census.

One comment suggested that the target support document lacks sufficient documentation and either a mathematical model or extrapolation of in-depth case studies. In response to this comment, FEA has reviewed the support documents and concludes that the data and methods of evaluation used in the document do support the target value.

One comment stated that the sampling of the companies and the depth of the investigation appear inadequate. FEA believes that the many data sources used were sufficient to provide an adequate target basis.

One comment questioned the commonality of processes among the three-digit product classifications. All components of SIC 35 share many of the common metalworking activities. These common processes, as further grouped in the three-digit classifications, provide an appropriate instrument for developing the target value.

One comment suggested that the conservation measures developed in establishing the SIC 35 target were for the most part already in use. The 1980 achievement deadline established by EPCA necessitated a "state-of-the-art" approach so that most of the identified measures already in use are to some extent in the industry. The SIC 35 target is based on projected energy savings to be achieved by further application of proven measures.

A final comment stated insufficient information and economic data were provided in the support documents. FEA responds that the support documents devote thirty-one pages and 10 tables to economic analysis. Additional detailed information and data are provided in the Volume I Backup Report. No additional information was received, and FEA believes that economic practicability and capital availability received adequate treatment during the target development.

B. *Final target values.* FEA has concluded that no changes to either the energy conservation levels or the final industry target are required as a result of the public comments. The final SIC 35 energy efficiency improvement target remains unchanged.

SIC 35 could lower its energy consumption in the target year from 707.32×10^{12} Btu to 588.40×10^{12} Btu if the energy for special circumstances is not considered, representing a gross conservation of 17% in energy efficiency improvement. After adjustment of the gross target for special circumstances SIC 35 could lower its consumption of energy in the target year to 601.33×10^{12} Btu. This would represent a net improvement in energy efficiency of 15 percent.

The following is the energy efficiency improvement target set by FEA for SIC 35:

	Percent
Gross target, based solely on technological feasibility and economic practicability	17
Offset, based on consideration of special circumstances	2
Net target, based on technological feasibility and economic practicability plus consideration of special circumstances	15

APPENDIX J. STATEMENT OF BASIS AND JUSTIFICATION FOR THE ENERGY EFFICIENCY IMPROVEMENT TARGET FOR SIC 37—TRANSPORTATION EQUIPMENT [1]

I. INDUSTRY DESCRIPTION AND ENERGY BASE

The transportation equipment industry, Standard Industrial Classification (SIC) 37, includes 17 four-digit product classifications. The following table shows energy consumption by each of the classifications in 1972, the base year:

SIC	Industry	1972 energy consumed (10^{12} Btu's)	Percent
3711	Motor vehicles and passenger car bodies	110.8	26.7
3713	Truck and bus bodies	12.1	2.9
3714	Motor vehicle parts and accessories	134.3	32.4
3715	Truck trailers	5.2	1.3
3721	Aircraft	32.1	7.7
3724	Aircraft engines and engine parts	24.6	5.9
3728	Aircraft parts and auxiliary equipment, n.e.c.	23.8	5.7
3731	Ship building and repairing	18.5	4.5
3732	Boat building and repairing	5.8	1.4
3743	Railroad equipment	16.1	3.9
3751	Motorcycles, bicycles and parts	4.2	1.0
3761	Guided missiles and space vehicles	9.5	2.3
3764	Propulsion units	7.6	1.8
3769	Guided missile and space vehicle parts and auxiliary equipment	2.4	.6
3792	Travel trailers and campers	3.5	.8
3795	Tanks and tank components	1.4	.3
3799	Transportation equipment, n.e.c.	2.4	.6
	Total	414.3	

The Standard Industrial Classification manual (1972) defines this industry by the classes of items produced or repaired. In general, the industry includes the manufacture of equipment for transportation of passengers and cargo by land, air, and water. Important products produced by SIC 37 include motor vehicles, aircraft, guided missiles and space vehicles, ships, boats, railroad equipment, and miscellaneous transportation equipment such as motorcycles, bicycles, and snowmobiles.

II. CRITERIA FOR APPLICABILITY OF POTENTIAL CONSERVATION MEASURES

Potential conservation measures were first screened for technological feasibility and the measures that survived the first test were then screened for economic practicability. The surviving measures were then analyzed to determine their contribution to the industry target. Because of the commonality of manufacturing processes at the three-digit level in SIC 37, the technological screening was performed at that level. The economic screening was made at the four-digit level to assure accuracy, but the results were aggregated at the three-digit level. Consequently, component goals were also computed at the three-digit level.

A. *Technological feasibility.* The following criteria were used to assess the technological feasibility of any proposed energy-efficient measure.

1. The technology had to be sufficiently developed, to be in operation in an actual or pilot plant.

[1] Target development for SIC 35, 37 was treated identically because of the similarity of the two industries.

2. The equipment or technical modification had to be capable of being in operation by the beginning of 1980.

3. The modification of equipment involved had to have direct application in the industries involved in the study.

4. If a process change was involved, it had to be sufficiently developed and proven by field applications to be acceptable to the industries affected.

5. Process changes had to be capable of being implemented and operational by January 1, 1980.

6. Changes to a more available form of energy had to be based on technology already available.

7. Changes from fuel fired to electrically heated equipment had to be based on availability of the equipment for installation by January 1, 1980.

8. Changes to electrically heated equipment had to be based on availability of the required amount of electric power by January 1, 1980.

Technological feasibility was further constrained by secondary factors associated with the industry. Conversions to electrically powered melting and heating equipment were limited to an identifiable percentage of existing installations because delivery times for electric induction and power distribution equipment are now more than two years in length. Additionally, since most foundry, forge shop and heat treating shop capacity is in the Midwest a serious impact on electric power availability will occur if there is a complete conversion to electric within the next two or three years. Despite the long-range potential for energy conservation by use of more efficient electric motors, FEA has concluded it would be impossible to change any large percentage of existing motors within the next few years, even if sufficient quantities were available by 1980.

Serious consideration was given to the potential for improving fuel fired heating furnace efficiency by the addition of insulation to the outside walls of steel furnaces and by substitution of lightweight refractories for conventional refractories. Some of the final energy savings are due to limited application of insulation and refractory changes. However, all furnaces have structural steel frameworks, and the majority have a plate or sheet shell for enclosing and sealing the refractory construction. Insulation cannot simply be added to the outside of the steelwork, since this would cause overheating of the steel. In most cases, it would be necessary to rebuild the furnaces completely in order to add insulation or to install lightweight refractories. While some of this can and will be done within the next few years, it would not be possible for many furnaces to be rebuilt in this way by January 1, 1980.

The final measures which were included principally involved improvements to melting and heating furnaces through improved insulation, combustion practice, waste heat recover, conversions from fuel fired melting and heating furnaces to electric equipment, and changes in processes involving coremaking and painting.

B. *Economic practicability.* The energy conservation measures which were determined to be technologically feasible were subjected to an economic analysis to determine their economic practicability. Elements of the criteria on which this analysis was based are the following:

1. Industry growth rates.
2. Energy cost projections.
3. General inflation projections.
4. Industry composite cost of capital.
5. Return on investment.
6. Capital availability.
7. Other factors, including utilization, age, location, and energy dependability.

III. CAPITAL SPENDING DECISIONS AND FINANCING CONSTRAINTS

A. *Required return on investment.* A total of 17 potential energy conservation measures were determined to be economically practicable as well as technologically feasible in one or more of the seven, three-digit components of the SIC 17 industry.

It would require $176 million to implement all of the acceptable 17 conservation measures over the period 1976 through 1979. The energy savings generated in the year 1980 would be about 34,000 billion Btu's or the equivalent of 1.46 million short tons of bituminous coal, 5.92 million barrels of distillate fuel oil, 10.10 billion kilowatt hours of electricity or about 34×10^9 cubic feet of natural gas. The following table shows the required capital investment and the potential energy savings for each of the 17 measures.

1980 energy saving and investment dollars per conservation measures

Conservation measure	Total program investment (in millions of dollars)	1980 energy savings (billion Btu's)
Painting: Drying catalytic incinerator	1,900.63	1,224.01
Ferrous foundry: Grey iron heat recovery process	2,929.82	1,672.09
Nonferrous foundry: Brass melting	230.56	124.39
Painting: Drying airless paint	4,901.55	2,448.01
Forging: Fuel fired conversion	12,356.51	5,560.92
Nonferrous die casting: Fuel fired conversion	1,038.11	388.81
Nonferrous foundry:		
Aluminum melt	2,042.45	647.89
Aluminum core making	326.81	103.66
Brass casting	36.63	11.51
Ferrous Foundry: Malleable iron to electric conversion	18,226.31	4,260.08
Forging: Electric conversion	48,879.20	9,252.75
Ferrous foundry: Grey iron to electric conversion	34,174.75	4,458.91
Power metallurgy conversion	1,121.13	141.10
Painting: Drying insulation	19,606.21	2,448.01
Heat Treating:		
Direct fired recoup	660.13	62.38
Steel heat treat	10,598.77	856.22
Painting: Baking insulation	17,190.57	807.55
Total	176,285.84	34,468.89

The following hurdle rates were determined for SIC 37 components from industry interviews and were converted from the payback periods in which they were utilized:

SIC	Industry	Hurdle rates (percent)
3711	Motor vehicles	26.0
3713	Truck bodies	
3714	Parts	
3715	Truck trailers	
3721	Aircraft	
3724	Air engines	
3728	Air equipment	
3731	Ship building	19
3732	Boat building	20
3743	Railroad equipment	19
3751	Motorcycles	42
3761	Missiles	20
3764	Space propulsion	
3769	Space vehicles	
3792	Campers	42
3795	Tanks	
3799	Equipment n.e.c.	

B. *Capital Spending Priorities.* Although a particular energy conservation project may be both technologically and economically feasible, there may exist overriding constraints which would foreclose ultimate implementation of a project by a firm. Among these considerations are:

(a) Capital availability in the industry.
(b) Plant utilization rates.
(c) Plant age.
(d) Geographic location.
(e) Lack of dependable energy supply source.
(f) Likely curtailment of natural gas supply.
(g) Collective bargaining agreements preventing process modification.
(h) Adverse effects on employee morale or company image.
(i) State and local government fiscal integrity.
(j) Employment.
(k) Regional economic activity.
(l) Prices.
(m) Low and middle income families.
(n) Small business.
(o) Sectoral completion.

Implementation of all economically feasible conservation programs in the transportation equipment industry would require $176 million in expenditures from 1976 to 1979. SIC 3711, the motor vehicle industry component, accounts for the largest capital investments ($ 152.4 million or 86 percent of total feasible investments) and the largest potential energy saving (30,000 billion Btu's or 98 percent of total savings) of all the feasible programs. Of conservation programs available to SIC 3711, the single largest required investment is the conversion to electricity of the forging process which requires nearly $49 million (or 28 percent) with resulting savings of 9.250 billion Btu's (or 27 percent). However, fuel fired forging conversions represent a much better savings per dollar invested. Ferrous foundry and painting conversions represent significant savings potential.

Total 1972 expenditure by SIC 37 for new plant and equipment was $2,663 million. Thus, the largest required annual expenditure of nearly $75 million in 1979 on the 17 feasible programs represents less than 3 percent of 1972 capital expenditures, and implementation should not be at all affected by the availability of capital funds.

IV. POTENTIAL ENERGY CONSERVATION MEASURES AND EFFORTS TO REDUCE USE OF PETROLEUM PRODUCTS AND NATURAL GAS

A detailed teratment of all potential energy conservation measures which were considered can be found in the target support documents which are available for examination at the locations and times specified in the body of this notice. This appendix will only discuss the major aspects of the assesament of potential energy conservation measures.

A. *Potential Measures Identified.* All components in SIC 37 use the same basic processes for metalworking and metalfinishing. Since these processes are the principal consumers of energy in the industry, potential conservation measures were associated with these basic processes. Measures involving significant capital expenditures were identified in the table given in III (A) above.

Additional conservation measures which were considered but eliminated by the screening process are:

1. Nonferrous foundry: electric melting.
2. Die casting: electric melting.
3. Heat treating: cascade heat recovery, electric heating.
4. Galvanizing: conversion to electric, waste heat recuperation.
5. Painting and coating: waste heat recuperation, combustion control equipment, electric drying.

No conservation measures requiring capital investment were identified for the following processes: electroplating, structural and plate fabrication, stamping, blanking, forming, assembly.

In addition to the process modifications which involve significant capital expendi-

tures, modifications in operating procedures were identified. These energy conserving measures for which no economic analysis was required are as follows:

TYPE OF EQUIPMENT AND NATURE OF IMPROVEMENT

1. Cupola furnace: Use of optimum iron-coke ratio control; careful coke handling to reduce breakage; tuyere maintenance to reduce air losses; repair leaks in blast air piping; maintain insulation on hot blast system; and Tap iron at minimum allowable temperature.

2. Electric arc furnace: Maintain refractories to minimize heat loss; maintain roof doors to minimize heat loss; Control rate of feed of electrodes; Control of furnace cycles to avoid peak loads.

3. Heating furnace: Maintain refractories and insulation; Seal up openings in walls and roof; Keep doors closed to minimize heat loss; Adjust fuel-air ratio to optimum setting; Shut down when not in use; Remove unused material from car bottoms.

4. Mechanical equipment: Good maintenance and lubrication; Shut down when not in use; Keep cutting tools and dies sharp; Drain chips and reuse cutting oils; Repair leaks in hydraulic systems.

5. Welding and brazing: Repair leaks in gas and oxygen lines; Shut off torches when not in use; Maintain welding tips in good condition.

6. Washing: Use lower temperature water; Combine or eliminate washing operations; Recirculate washer and rinse waters.

The potential conservation measures which could be most easily implemented with a minimum of capital expenditures involve the buildings and services in manufacturing establishments. From 25 to 50 percent of total energy consumed by SIC 37 is expended for building heating, ventilating, air conditioning, lighting, and other miscellaneous plant services. A tabulation of the more important potential housekeeping improvements is provided.

AREA AND NATURE OF IMPROVEMENT

1. Buildings: Close building openings; Repair broken walls, windows; Insulate walls and roofs; Isolate space not used for products; Install translucent panels to reduce lighting requirements.

2. Heating, ventilating, air conditioning; Reduce temperatures of heating; Increase temperature of cooling; Reduce air changes per hour; Recirculate air where possible; Heating with waste process heat; Reduce heating to minimum in nonworking areas; Close all unnecessary openings.

3. Lighting: Reduce lighting levels to minimum; Turn lights out in nonworking areas; Use more efficient lighting systems; Use timers to control lighting.

4. Boiler houses: Convert to coal heating; Maintenance improvement on boilers; Combustion control on boilers; Use plant wastes for heating; Install air preheaters using waste heat.

5. Piping systems: Repair leaks in pipelines; Turn off air and water nozzles; Install insulation on steam lines:

6. Electrical systems: Install efficient wiring; Use power factor correction; Reduce motor sizes where possible.

B. *Efforts to Reduce Consumption of Petroleum Products and Natural Gas.* Conservation efforts in SIC 37 vary greatly among the companies. The degree of implementation and sophistication of conservation efforts appeared to be a function of the size of the entities with the larger companies generally demonstrating greater progress in conservation activities. No overall industry effort to reduce consumption of petroleum products and natural gas was evident. Since the industry spends less than 3 percent of its cost of operation for fuels, there is no high priority on conserving energy.

However, recurrent gas curtailments have stimulated a conversion from gas-fired equipment to oil or electricity.

V. DRAFT TARGET DEFINITION

A. *Component Goals.* The detailed evaluation of the best available information in the target support documents resulted in component goals as shown in the following table:

	Component goals (percent)
SIC 3711, 3713, 3714, 3715: Motor vehicle and equipment	[1] 19.4
3721, 3724, 3728: Aircraft equipment	[1] 16.0
3731, 3732: Ship and boat building	[1] 17.8
3743: Railroad equipment	[1] 19.7
3751, 3792: Motorcycles, bicycles and 3795, 3799 miscellaneous transportation equipment	18.0
SIC 3761, 3764, 3769: Aerospace equipment	15.3

[1] SIC.

B. *Proposed Two-digit Gross Target.* For each industry component, the 1980 energy use at 1972 energy efficiency is shown in column A of the following table. Similarly, for each component, the 1980 energy use for each component as recorded in column C was determined by subtracting the energy to be saved from using energy conservation measures as recorded in column D from column A. The two-digit gross target value for SIC 37 is determined below by subtracting the total in column C from the total in column A, dividing by the total in column A and multiplying by 100.

Gross target development

	(A) 1980 energy use at 1972 energy efficiency (10^{12} Btu)	(B) Percent improvement by 1980 for each component	(C) 1980 energy use if gross target is achieved (10^{12} Btu)	(D) Energy improvement by 1980 for each component (10^{12} Btu)
Component:				
3711, 13, 14, 15	467.169	19.4	376.388	90.781
3721, 24, 28	126.409	16.0	106.228	20.181
3731, 32	32.994	17.8	27.122	5.872
3743	21.879	19.7	17.571	4.308
3751, 92, 95, 99	15.563	18.0	12.768	2.795
3761, 64, 69	26.464	15.3	22.422	4.042
Total	690.478	[1]	562.499	

[1] Tg = gross energy improvement target = $\frac{A-C}{A} \times 100$

$Tg = \frac{690.478 - 562.499}{690.478} \times 100 = 19$ pct

C. *Special Circumstances Effect.* Special circumstances are conditions which are beyond the control of that industry and which result in additional energy consumption. Examples of special circumstances in SIC 37 are pollution control and occupational safety and health requirements such as pollution control in ferrous foundry operations, water pollution control in electroplating operations and increased ventilation to remove or to eliminate in-plant airborne particles, vapors and fumes.

D. *Proposed Two-Digit Net Target.* For each component in SIC 37, the additional energy required by special circumstances was determined in units of Btu's and recorded in column C in the following table. The gross component goals were adjusted by adding this additional figure to column B to obtain the 1980 net energy use in column D. The two-digit net target percentage for SIC 37 is then calculated by subtracting the total in column D from the total in column A, dividing by the total in column A, and multiplying by 100.

	(A) 1980 energy use at 1972 energy efficiency (10^{12} Btu)	(B) 1980 energy use if gross target is achieved (10^{12} Btu)	(C) Energy for special circumstances (10^{12} Btu)	(D) 1980 energy use if net target is achieved (10^{12} Btu)
Component:				
3711, 13, 14, 15	467.169	376.388	12.640	389.028
3721, 24, 28	126.409	106.228	2.417	108.645
3731, 32	32.994	27.122	.695	27.817
3743	21.897	17.571	.463	18.034
3751, 92, 95, 99	15.563	12.768	.373	13.141
3761, 64, 69	26.464	22.422	.451	22.873
Total	690.478	[1]		579.538

[1] T_n = net energy efficiency improvement target = $\frac{A-D}{A} \times 100$

$T_n = \frac{690.478 - 579.538}{690.478} \times 100 = 16.1$ pct, use 16 pct.

VI. FINAL TARGET DEFINITION

A. *Comments and Impact on Proposed Target.* Testimony presented at the public hearing and timely written comments have been thoroughly reviewed. Three corporations and one trade association offered comments. Several comments addressed the substance of the support documents, particularly the assessment of appropriate conservation measures. Only a few of the comments indicated specific criticism requiring reconsideration of methodology and target value.

One commenter noted that energy projections for cupola melting was different in the support documents for SIC 33 in which cupola melting is also used and that the assigned energy consumption for foundry operations in the base year also differed significantly in the two reports. FEA was aware of the different energy savings projection for cupola melting and an investigation revealed that this variation was primarily caused by differences in data sources, target synthesis methodology, and identification and inclusion of sources of energy used in each foundry In SIC 37, only the energy requirements for the particular processes being investigated, i.e., cupola or electric melting were calculated during a company visit. Savings calculated directly from individual foundry processes will justifiably be different from a savings based on projections from the foundry as a whole. Both approaches are valid. As to the difference in baseline foundry energy, again, different data sources and methodologies are responsible for (some of) the disparity.

One comment challenged the support documents' conclusion as to the effects of the change in the quality of foundry coke. While some foundries have complained of coke quality, they did not report significant increases in coke consumption and FEA affirms its assumption of reasonably constant coke quality.

Some comments criticized the support documents for overstating the potential savings from cupola control investment and offgas recuperation. While some major automotive producers have already made improvements in cupola operating control, FEA concludes that many other companies in SIC 37 can still make improvements in cupola operation to yield the estimated reductions in energy consumption. Many cupolas operate with an overall iron to coke ratio average of 5 or 6 to 1, when it is recognized that 8 to 1, and even 10 to 1, ratios are possible with maximum attention to all practical coke saving practices.

Some concern was voiced as to whether energy consumption due to special circumstances particularly OSHA standards under the National Emphasis Program scheduled for January 1977, were adequately considered. No offset for energy consumed to meet OSHA regulations was found to be necessary. While a major focus of future OSHA regulations will certainly be the foundry industry, recent studies suggest that means will be developed to reduce any anticipated energy requirements for compliance with future OSHA regulations. As provided by EPCA 374(d), the impact of future requirements may be assessed at any future time indicated by the Administrator.

A number of comments criticized the assumptions about data that was used for the study. While FEA recognizes that the values assigned to these assumptions might change before 1980, it was necessary to hold certain values constant to permit completion of the work. EPCA, section 374(d), provides for target reassessment and adjustment for significantly changed conditions.

It was also commented that the reports did not appear to recognize that design changes in motor vehicles to improve fuel economy could result in more energy consumptive manufacturing processes. While FEA recognizes that the addition of parts to provide for increased safety, reduced emission levels, and reduced noise levels may increase the energy necessary to produce each vehicle, FEA concludes that no change in the target value is justified at this point, because the overall impact of these additional requirements on energy consumption for production has not yet been determined. As noted above, provisions are contained in the EPCA for target reassessment and adjustment.

One criticism leveled at the target study stated that "* * * energy consumption which is reduced due to decreased production is not 'real' conservation." FEA recognized that decreased production can give an apparent increased improvement in energy efficiency, and this factor was considered in setting the proposed target.

There is some concern that the more advanced companies may be penalized because they implemented conservation measures earlier and, therefore, have less opportunity for improving their efficiency between 1976 and 1977. This is not a handicap because all advances made in conservation between the base year, 1972, and the target year, 1980 are to be noted.

There was some concern that conservation measures which are based on conversion to electricity should not be considered because electrictly can require higher Btu expenditure at the utility rate. While strong arguments exist for central electricity generation, FEA concludes that the effects of conversion to electricity beyond the manufacturing facility are out of the scope of the target study.

Some commenters questioned the usefulness of setting two-digit goals since most companies are not operated on a two-digit basis. The two-digit target represents the most useful analysis of the best available data on energy consumption by SIC 37, and targets at the two-digit level are required by the EPCA.

B. *Final Target Values.* Since an evaluation of the above comments did not result in a revision of the proposed target value, the final SIC 37 industry target is the same as the proposed target.

SIC 37 could lower its energy consumption in the target year from 690.47 x 10^{12} Btu to 562.49 x 10^{12} Btu of the energy for special circumstances is not considered, representing a gross conservation of 18% in energy efficiency improvement. After adjustment of the gross target for special circumstances, SIC 35 could lower its consumption of energy in the target year to 579.53 x 10^{12} Btu. This would represent a net improvement in energy efficiency of 16%.

The following is the energy efficiency improvement target set by FEA for SIC 37:

	Percent
Gross target, based solely on technological feasibility and economic practicability	18
Offset, based on consideration of special circumstances	2
Net target based on technological feasibility and economic practicability plus consideration of special circumstances	16

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